# SOUTH SASKATCHEWAN RIVER BASIN NON-IRRIGATION WATER USE FORECASTS

**MARCH 2002**


Alberta
ENVIRONMENT

Canadian Resource Economics Ltd.

Hydroconsult

For copies of this report, contact:

Information Centre
Alberta Environment
Main floor, Great West Life Bldg.
9920-108 Street
Edmonton, Alberta
T5K 2M4

Pub. No: T/656
Printed Edition ISBN: 0-7785-2154-0
On-line Edition ISBN:0-7785-2155-9
Web Site: http://www3.gov.ab.ca/env/

**Hydroconsult**
**EN3 Services Ltd.**

3100, Bow Valley II
205 - 5 Avenue S.W.
Calgary, Alberta
Canada T2P 2V7

Phone: (403) 265-6958
Fax: (403) 263-9818

www.hydroconsult.com

March 26, 2002 File: 448

Mr. Bob Morrison, Planner
Alberta Environment
Natural Resources Service - Bow Region
301, 2938 - 11 Street N. E.
Calgary, Alberta, T3H 1H5

Dear Mr. Morrison:

**SUBJECT: South Saskatchewan River Basin Non-Irrigation Water Use Forecasts**

We are pleased to submit the above-captioned final report for circulation. This version incorporates changes made in response to comments received on the draft report from yourself, other department personnel and the responding jurisdictions based on our web-site posting.

We appreciate the assistance of the many people contacted, the numerous jurisdictions that responded to our questionnaire as listed in Appendix B, and in particular the extensive cooperation provided by you and your colleagues at Alberta Environment.

We have enjoyed working on this assignment and trust that it will serve to advance future water management and planning in the South Saskatchewan River Basin. Please contact either of the undersigned if you have any further questions or comments.

Yours truly,

**HYDROCONSULT** EN3 Services Ltd.

Dave L. Cooper, P. Eng
Vice-President/Senior Project Manager

Canadian Resource Economics Ltd.

Paul Cox, Ph. D., Principal
Tel: (403) 938-5958

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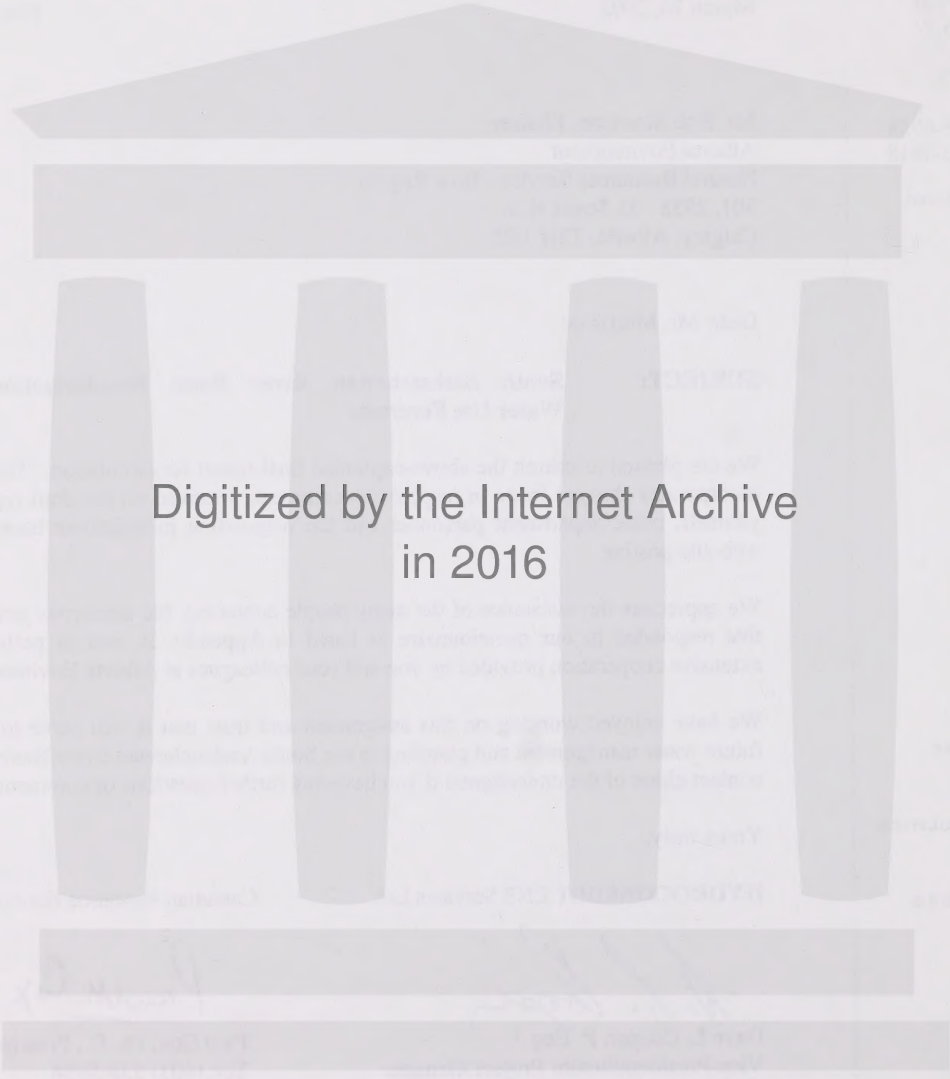

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**CONVERSIONS**

1 $dam^3$ (cubic decametre) = 1 000 $m^3$ (cubic metres)
1 acre – foot = 1.233 $dam^3$ 1 $dam^3$ = 0.811 acre-feet
1 acre – foot = 271,810 imperial gallons 1 $dam^3$ = 220,362 imperial gallons
1 $m^3$/person/year = 2.74 litres/person/day

# EXECUTIVE SUMMARY

## Purpose

Alberta Environment (AENV) commissioned this study as part of the South Saskatchewan River Basin Water Management Review. The study presents long-term forecasts for population and water demand (withdrawals and consumptive use) to assist with water management planning in the basin. The major water use categories quantified are municipal, industrial, stockwatering, other agricultural (non-irrigation) and water management (Water management uses include licensed projects involving lake stabilization, remediation and flood control.).

## Scope

The study area is the Alberta portion of the South Saskatchewan River Basin (SSRB) comprising the Red Deer, Bow, and Oldman River basins and the South Saskatchewan River sub-basin. This area, covering almost one-quarter of the province of Alberta, is further broken down into 26 sub-basins.

The year 1996 was used as a baseline because it is a year for which population data are available from Statistics Canada. Forecasts were made to the years 2021 and 2046 corresponding to 25 and 50 years into the future. Three scenarios (low, medium, and high) were developed to reflect the probable range of growth.

## Methodology

Preparation of these forecasts relied on existing data, background documents, existing forecasts, expert opinion on population and economic development, and interviews with AENV and other public sector officials. In addition, questionnaires were sent out to each of the 128 jurisdictions (municipal governments, First Nations and irrigation districts) in the study area.

The current study relied to a large extent on the methodology used in the report *Non-Irrigation Consumptive Demand Forecasts – Little Bow Project EIA*, prepared by Hydroconsult for AENV in July 1999.

Data were collected on current population and economic activity (Chapter 2.0) and estimates were made concerning water use for 1996 (Chapter 3.0). Forecasts of population and economic activity were developed for 2021 and 2046 (Chapter 4.0). Withdrawals and consumptive use were forecasted for the target years based on low, medium and high growth scenarios (Chapter 5.0).

The time period used for these forecasts extends quite far into the future and as a result must be considered as "ballpark" estimates. A number of assumptions required to fill data gaps are documented throughout the report. No distinction is made in this study

between ground and surface water supply sources and no limitations are assumed or placed on supplies to meet demands.

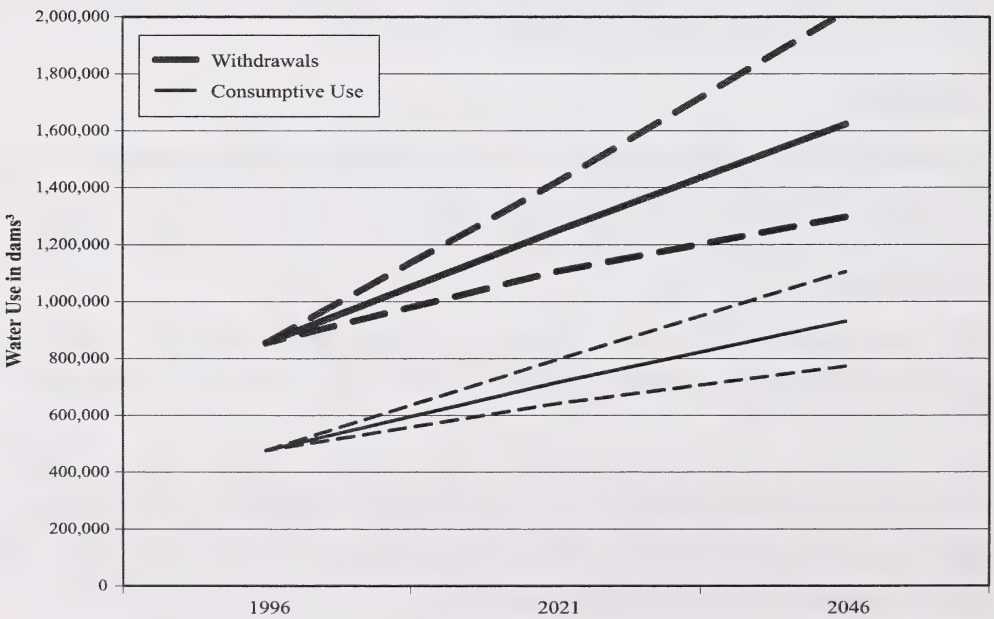
**Summary of Results**

The population of the SSRB is expected to grow from 1,300,000 in 1996 to between 1,890,000 and 2,120,000 in 2021. By 2046, the population of the SSRB is expected to grow to between 2,370,000 and 3,180,000.

Demand for non-irrigation water withdrawals in 2021 is forecasted to increase between 29% and 66% over 1996 withdrawals of 854,420 cubic decametres ($dam^3$). Non-irrigation consumptive use (including losses) in 2021 is forecasted to increase between 35% and 67% over 1996 consumptive use of 469,270 $dam^3$.

By the year 2046, demand for non-irrigation water withdrawals is forecasted to increase between 52% and 136% over 1996 and consumptive use is forecasted to increase between 63% and 132% over 1996. Forecasted withdrawals and consumptive use for the study area are illustrated below with medium case values shown by the solid lines.

**Figure ES-1 Projected Growth in SSRB Water Use**



As one would expect from a study area that is geographically varied, results differed greatly among the basins and sub-basins of the study area as summarized in Figures ES-2 and ES-3 below for the medium growth case.

The Bow River basin has the largest non-irrigation withdrawals in the SSRB throughout the forecast period, accounting for 44% of the SSRB total in 2046. However, the Red Deer River basin accounts for the largest share of non-irrigation consumptive use throughout the period, with 35% of the SSRB total in 2046.

The greatest volumetric increase in water withdrawals are expected to take place in the Bow River basin, where the medium case volume for 2046 is 202% (362,000 $dam^3$) above 1996 levels. The greatest rise in consumptive use is forecasted in the Red Deer River in 2046, where the medium case volume shows a 103% increase (164,520 $dams^3$) over 1996.

In terms of water withdrawals, the municipal water use category continues to be predominant, although its share is expected to decline slightly (from 44% in 1996 to 40% in 2046), largely as a function of water conservation measures. Industrial use, in second place, is expected to show the greatest increase in water demand with its share growing from 17% in 1996 to over 28% in 2046. The proportion of withdrawals used for water management and stockwatering are expected to decline. The proportion of withdrawals for other non-irrigation agricultural use is expected to remain stable.

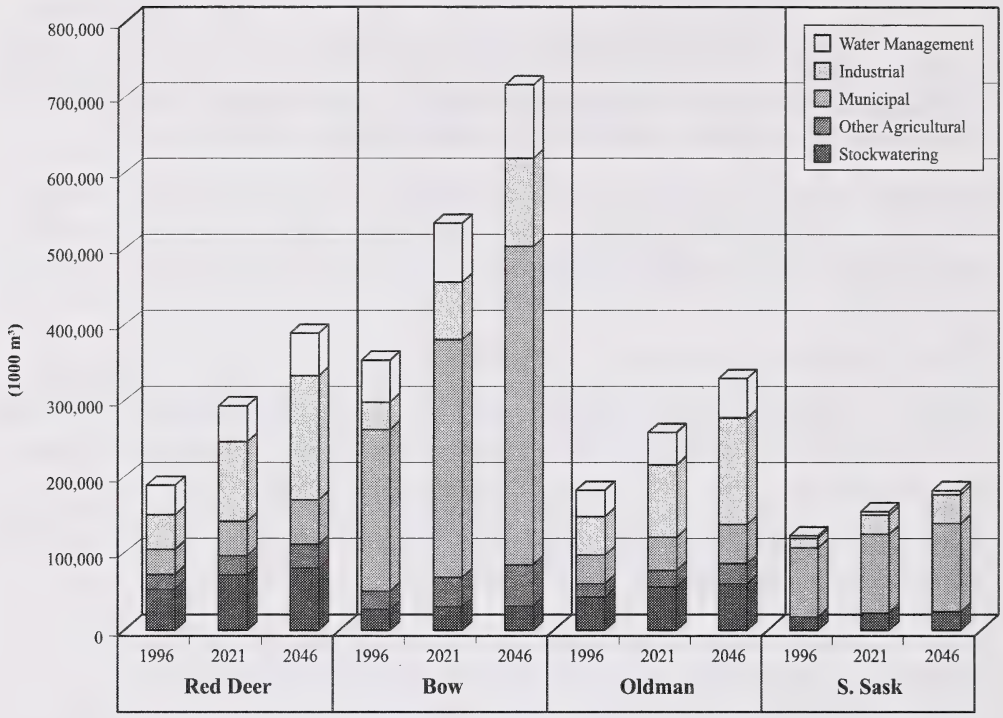
Industrial consumptive uses are expected to surpass stockwatering as the greatest non-irrigation consumptive use, increasing markedly over the forecast period (from a 25% share in 1996 to 39.9% in 2046). Stockwatering decreases from 30.1% in 1996 to 21.6% in 2046 and municipal consumptive use decreases from 20.1% in 1996 to 17.2% in 2046. The proportions of consumptive use for water management and other agriculture are also expected to decline.

The forecasted water use by major basin and use categories is illustrated in the charts on the following page.

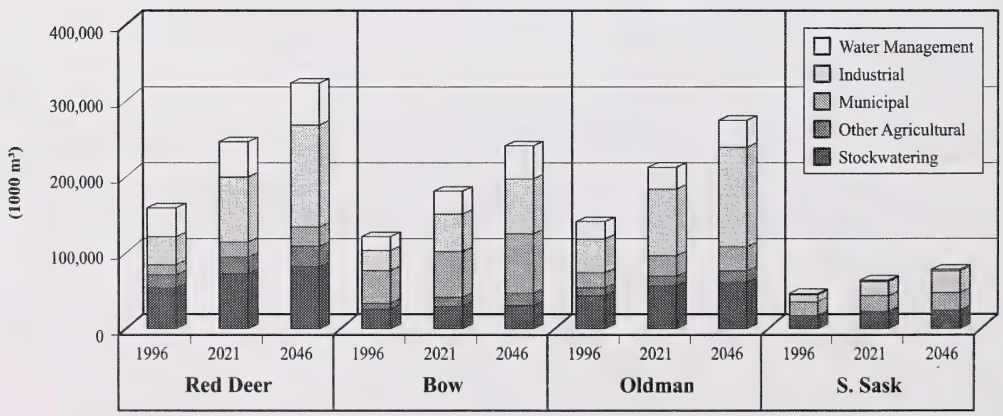
Per capita withdrawals and consumptive use are forecasted to decrease as a result of demand management initiatives. Withdrawals are expected to decline from 659 $m^3$/person/year in 1996 to 585 $m^3$/person/year in 2046. Consumptive use is expected to decline from 362 $m^3$/person/year in 1996 to 331 $m^3$/person/year in 2046.

**Figure ES-2**

**Medium Case Withdrawals Use by Basin and Use Category**




**Medium Case Consumptive Use by Basin and Use Category**



# 1.0 INTRODUCTION

## 1.1 BACKGROUND

Hydroconsult, in association with Canadian Resource Economics, was contracted by Alberta Environment (AENV) to develop forecasts for population and water use (both withdrawal and consumptive use) for the South Saskatchewan River basin in Alberta (SSRB).

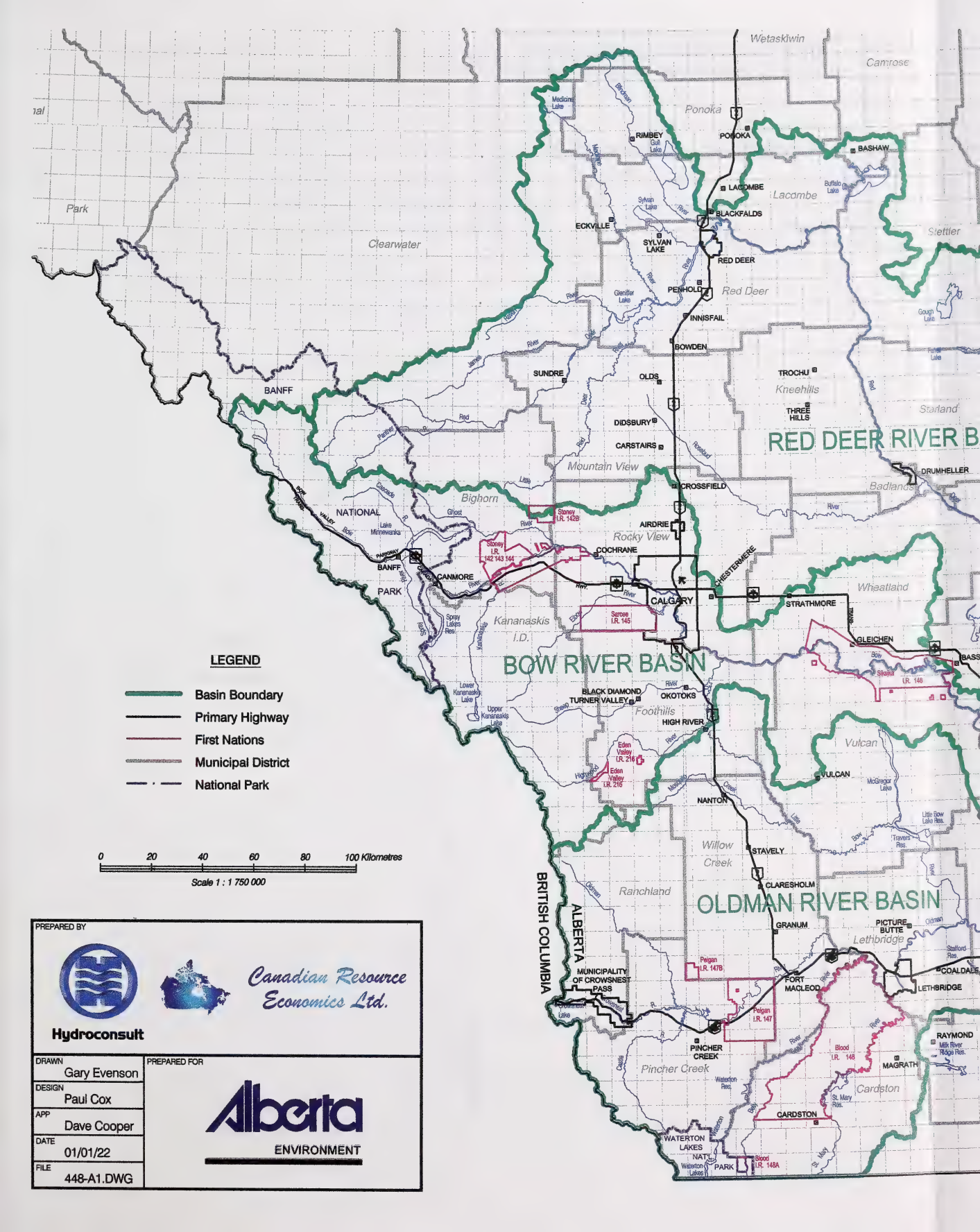
Municipal (including rural household and water co-operatives), industrial and agricultural (other than irrigation) water uses are to be identified separately as indicated in the Terms of Reference (ToR) in Appendix A.

Demand forecasts are to be identified for current conditions (taken as 1996 – the most recent census year) and for 2021 and 2046.

The study area is the South Saskatchewan River basin encompassing the Red Deer, Bow and Oldman River basins and the portion of the South Saskatchewan River basin included within Alberta, as shown in Figure 1-1. This study area covers over 100 jurisdictions including 5 cities, 19 counties, 6 First Nations, 8 Municipal Districts, 1 Improvement District, 1 Municipality, 13 Irrigation Districts, 2 National Parks, 3 Special Areas and at least 48 towns. The 44 villages and 12 summer villages in the study area were considered only when they appeared to be significant water users. The Towns of Lacombe and Ponoka although located outside the SSRB basin, were included in the study as they might obtain water from inside the basin in the future.

The ToR specified that the forecasts were to be calculated for individual municipalities and grouped into 26 sub-basins, as listed below and as illustrated in Figure 1-2. These sub-basins have been identified by AENV as sub-basins to be used for water management planning. The St. Mary River sub-basin is sub-divided in some instances into its natural drainage and the internal drainage basin to the east that it supplies (the latter is referred to as ST-M-SUB).

As specified in the ToR, no distinction is made between surface water and groundwater sources, and no assumptions are made regarding the role of potential new storage facilities, water rights transfers or limitations in supply.


Wetaskiwin
Camrose
Ponoka
RIMBEY
PONOKA
BASHAW
LACOMBE
Lacombe
BLACKFALDS
ECKVILLE
SYLVAN LAKE
RED DEER
Red Deer
PENHOLD
INNISFAIL
BOWDEN
Clearwater
Stettler
BANFF
SUNDRE
OLDS
TROCHU
Kneehills
THREE HILLS
Starland
DIDSBURY
CARSTAIRS
RED DEER RIVER B
Mountain View
DRUMHELLER
CROSSFIELD
Badlands
Bighorn
NATIONAL PARK
BANFF
AIRDRIE
Rocky View
COCHRANE
CANMORE
CALGARY
CHESTERMERE
STRATHMORE
Wheatland
Kananaskis I.D.
BOW RIVER BASIN
GLEICHEN
BLACK DIAMOND
TURNER VALLEY
OKOTOKS
Foothills
HIGH RIVER
Vulcan
VULCAN
NANTON
Willow Creek
STAVELY
CLARESHOLM
Ranchland
OLDMAN RIVER BASIN
GRANUM
PICTURE BUTTE
Lethbridge
COALDALE
LETHBRIDGE
MUNICIPALITY OF CROWSNEST PASS
FORT MACLEOD
PINCHER CREEK
Pincher Creek
MAGRATH
Cardston
CARDSTON
WATERTON LAKES NAT. PARK
RAYMOND
BRITISH COLUMBIA
ALBERTA
LEGEND
Basin Boundary
Primary Highway
First Nations
Municipal District
National Park
0 20 40 60 80 100 Kilometres
Scale 1 : 1 750 000
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Hydroconsult
Canadian Resource Economics Ltd.
DRAWN Gary Evenson
DESIGN Paul Cox
APP Dave Cooper
DATE 01/01/22
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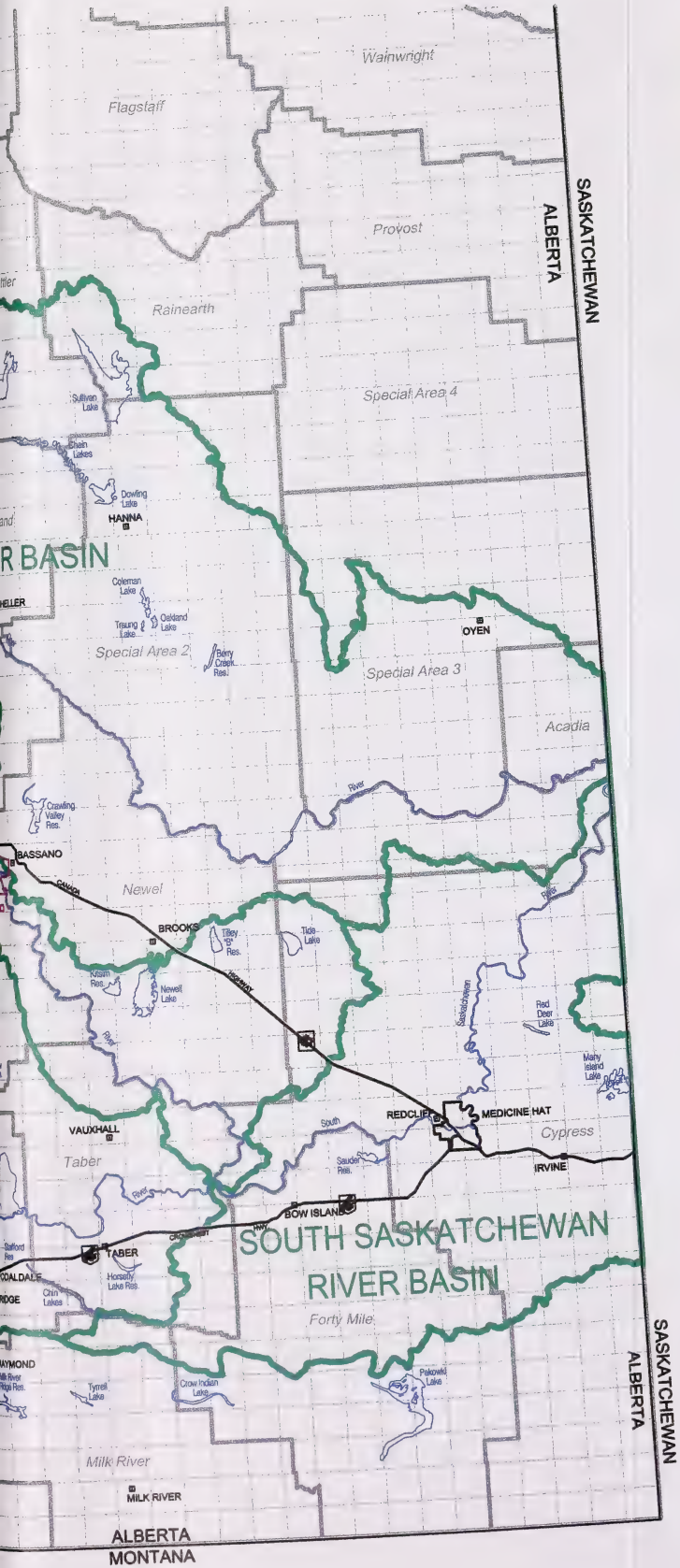
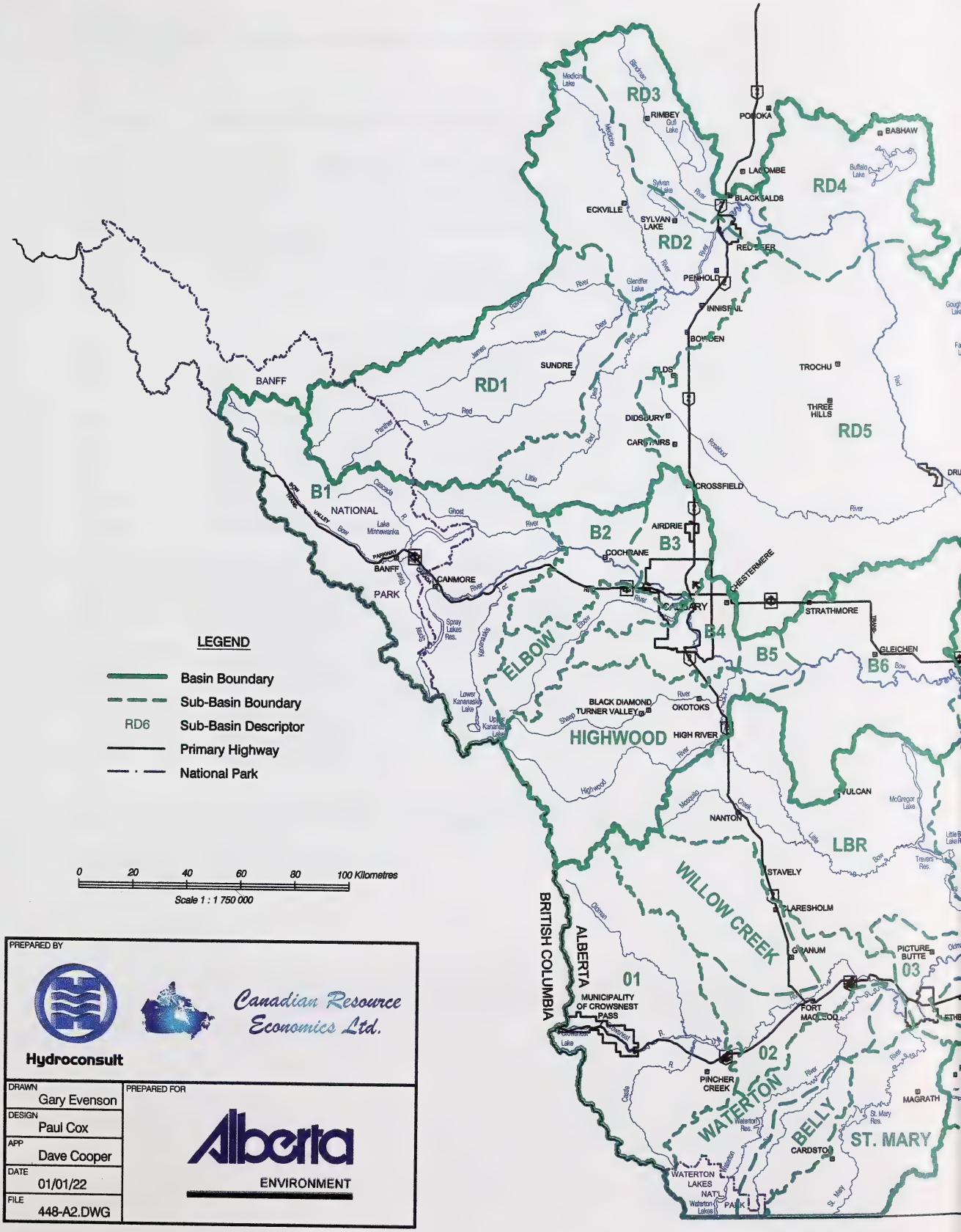
SOUTH SASKATCHEWAN RIVER BASIN
NON-IRRIGATION WATER USE FORECASTS

**STUDY AREA MAP**

Figure 1-1



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Canadian Resource Economics Ltd.

| | |
|---|---|
| DRAWN | Gary Evenson |
| DESIGN | Paul Cox |
| APP | Dave Cooper |
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## STUDY AREA SUB-BASINS

Figure 1-2

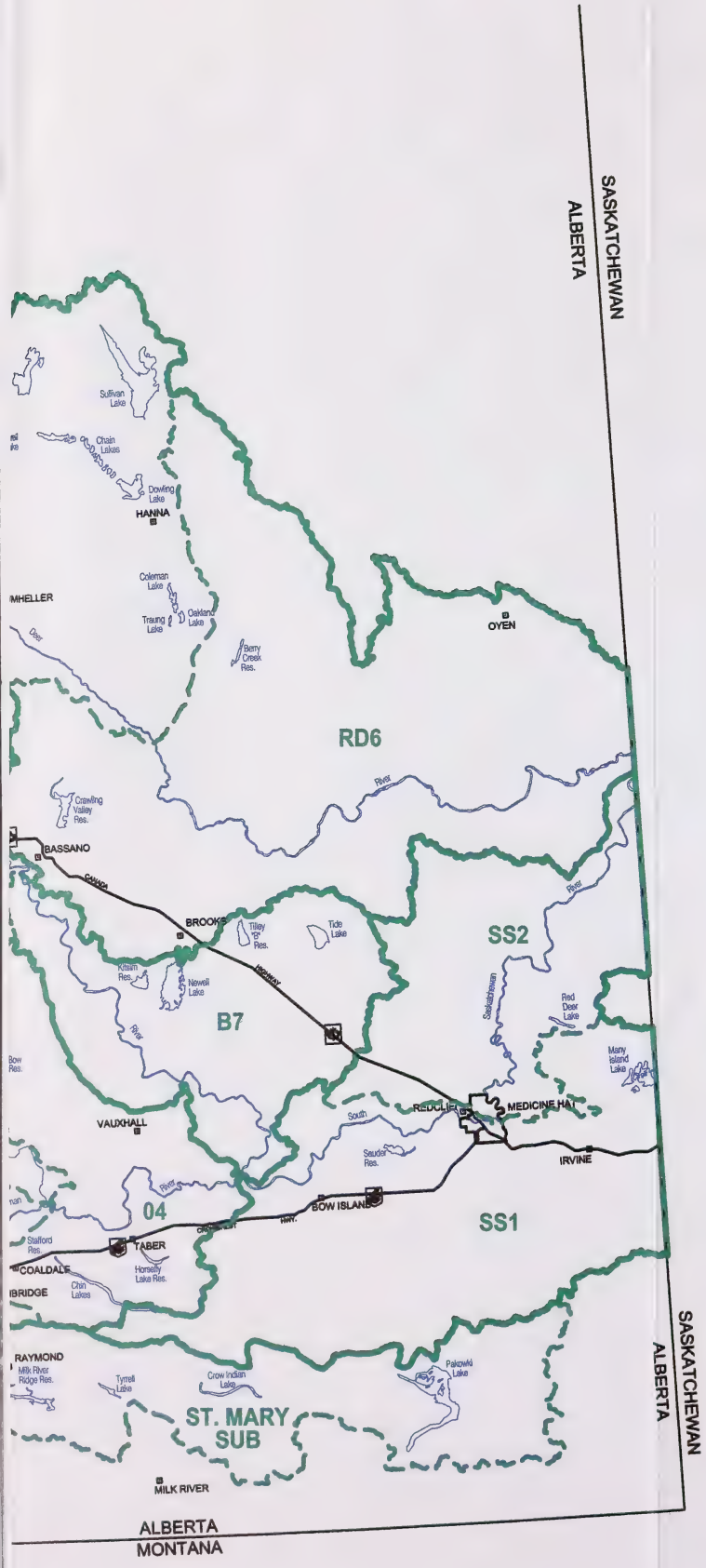


**Table 1.1 South Saskatchewan River Basin Study Sub-Basins**

| | |
|---|---|
| RD1 | Red Deer River upstream of Dickson Dam |
| RD2 | Red Deer River from Dickson Dam to Red Deer |
| RD3 | Red Deer River from Red Deer to Joffre industrial complex |
| RD4 | Red Deer River from Joffre industrial complex to Special Areas Water Supply Project (SAWSP) diversion |
| RD5 | Red Deer River from SAWSP diversion to Deadfish diversion |
| RD6 | Red Deer River from Deadfish diversion to the mouth |
| B1 | Bow River upstream of Ghost Dam |
| B2 | Bow River from Ghost Dam to Bearspaw Dam |
| B3 | Bow River from Bearspaw Dam to Western Headworks weir (including the Elbow River downstream of Glenmore Dam) |
| B4 | Bow River from Western Headworks Weir to Highwood River |
| B5 | Bow River from Highwood River to Carseland weir |
| B6 | Bow River from Carseland weir to Bassano Dam |
| B7 | Bow River from Bassano Dam to the mouth |
| ELBOW | Elbow River upstream of Glenmore Dam |
| HIGH | Highwood River sub-basin |
| O1 | Oldman River upstream of Oldman Dam |
| O2 | Oldman River from Oldman Dam to Lethbridge |
| O3 | Oldman River from Lethbridge to Little Bow River |
| O4 | Oldman River from Little Bow River to the mouth |
| WATERTON | Waterton River sub-basin |
| BELLY | Belly River sub-basin |
| ST-M | St. Mary River sub-basin including ST-M-SUB, the internal drainage basin supplied by the St. Mary's River Irrigation District |
| WILLOW | Willow Creek sub-basin |
| LBR | Little Bow River sub-basin |
| SS1 | South Saskatchewan River from Bow-Oldman confluence to Medicine Hat |
| SS2 | South Saskatchewan River from Medicine Hat to Red Deer confluence |

Note: "to" above means up to and including

## 1.2 BASIS

The study uses the report *Non-Irrigation Consumptive Demand Forecasts - Little Bow Project EIA*, prepared by Hydroconsult and Worldwide Resource Economics for AENV as a methodological guide.

The current study involved the collection and review of data from a variety of sources including:

- relevant documents as encountered, e.g., the South Saskatchewan River Basin Planning Program (SSRBPP) documents prepared in 1984 by Alberta Environment;
- master lists of licence files compiled by the AENV Water Administration Branch in the Environmental Management System (EMS) up to March 21, 2000 and reviewed by the Parkland, Bow and Prairie region offices;
- permit files from the Municipal Approvals Group/Water and Wastewater identifying treatment plant inflows/outflows;
- summary lists of water licence applications in progress to assess the nature of some of the new licences which might receive approval in the near future;
- interviews with AENV officials (see Appendix B) to understand more fully the nature of the files consulted and to address the limitations of the data being reviewed and the significance of missing/unavailable data;
- questionnaire responses (61 of 128 sent out or 48%, see sample questionnaire in Appendix C), e-mail and telephone contact with officials in municipal jurisdictions throughout the study area plus previous work in the Highwood and Little Bow basins (Hydroconsult, 1999) to address historical water use, population, economic activity, and forecasted water use; and
- interviews with officials in several government departments and bodies other than AENV, such as Statistics Canada, Alberta Treasury, Alberta Health, Alberta Economic Development, Alberta Agriculture, Food and Rural Development, the City of Calgary and the University of Alberta's Population Research Laboratory (see Appendix B).

A major difference between the current study and the report *Non-Irrigation Consumptive Demand Forecasts -Little Bow Project EIA* was the absence in the current study of face-to-face interviews with municipal officials.

## 1.3 DEFINITIONS AND ASSUMPTIONS

The base year for population projection calculations, 1996, was selected because it is a year for which population data are available from Statistics Canada. The years 2021 and 2046 were chosen simply as the years corresponding to 25 and 50 years from that date into the future. Licence data up to March 2000 were compiled and used to provide a short-term comparison with the licence data to 1996, as discussed later.

As will be seen in Section 4, none of the agencies that have produced recent population forecasts for the entire study area has attempted forecasting beyond 2016. The Cities of Calgary, Red Deer and Lethbridge, as well as a handful of smaller municipalities, have

prepared long-range forecasts but these appear to be of varying quality and designed primarily for land annexation planning. The time span selected for the population forecasts in this study extends well beyond the limits of what is considered by most professional demographers and economists as a manageable forecasting period.
Throughout the study, water withdrawals were taken to equal consumptive use plus return flows. Losses, due to factors such as evaporation and seepage, were treated as a component of consumptive use.

For simplicity, metric units of measurement were utilized in all water-related tabulations. Conversion rates for acre-feet and imperial gallons are given at the end of the Table of Contents.

As per the ToR, a connection is assumed between surface and ground water. In other words, this study did not distinguish between alternative types of water source. The focus was on demand in the 4 principal basins and 26 sub-basins from each of the major use categories whether supply was satisfied from mainstream surface flows, tributaries or groundwater.

## 1.4 CONTENTS OF THIS REPORT

Historical population data including livestock numbers and an overview of economic activity in the SSRB are presented in Chapter 2. Current water use based on license data and estimates of current actual water use by use category are presented in Chapter 3. Estimates of seasonal and annual variations in use are included in Chapter 3. The methodology for population forecasts and estimates of future economic activity are provided in Chapter 4. Population forecasts to 2046 are presented by sub-basin. Chapter 5 combines the forecast information in Chapter 4 and current use data in Chapter 3 to forecast water use by sub-basin. Water use forecasts are summarized by use category, sub-basin and on a per capita consumption basis. Recommendations for further study, data compilation and future forecasts are presented in Chapter 6.

The report includes figures and summary tables in the text, numbered according to chapters. Detailed data summaries are provided in the tables in Appendix D. The other appendices include:

- the original Terms of Reference for this study in Appendix A (effluent discharge and irrigation use aspects were subsequently deleted for this study);
- a list of persons consulted including jurisdictions responding to the questionnaire in Appendix B;
- a sample questionnaire for municipalities in Appendix C;
- an independent review of the population forecasts and methodology in Appendix E; and
- a list of references in Appendix F.

# 2.0 CURRENT POPULATION AND ECONOMIC ACTIVITY

## 2.1 HISTORICAL POPULATION

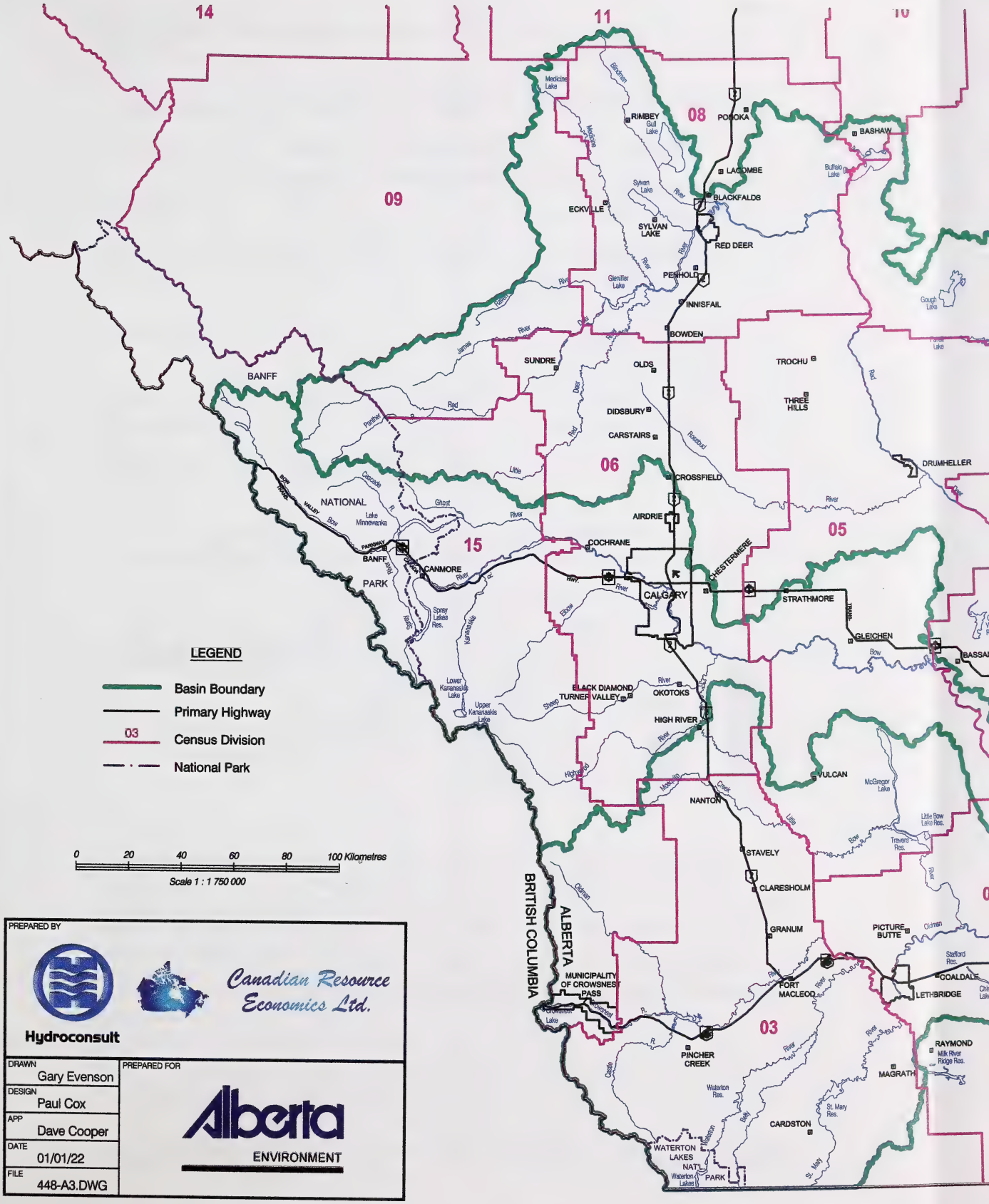
The study area, defined as that portion of the South Saskatchewan River Basin lying within the province of Alberta, is approximately 157,400 $km^2$ in area or 24.7% of the surface area of Alberta.

The first step was to identify the Census Divisions (CDs) and Census Sub-Divisions (CSDs) situated within the study area. Figure 2-1 shows the degree of fit between the Census Divisions and the main river basins. In total, 12 Census Divisions and 150 Census Sub-Divisions are located within or partially within the SSRB (in subsequent analysis only 10 CDs were considered due to the fact that overlap between the study area and CDs 10 and 11 was negligible). Population totals for each of the Census Sub-Divisions were assembled from Statistics Canada censuses for 1981, 1986, 1991 and 1996.

The four basins (Red Deer, Bow, Oldman and South Saskatchewan) and 26 constituent sub-basins within the SSRB were overlaid on the Statistics Canada map showing Census Division and Census Sub-Division boundaries. The 1996 population totals for each Census Sub-Division were then allocated to sub-basins. In instances where the Census Sub-Divisions (principally counties and municipal districts) crossed sub-basin boundaries, rural populations were allocated on the basis of area.

The population for the study area for 1981, 1986, 1991 and 1996 is shown in Table D1. The total estimated population for the study area in 1996 is 1,297,147, equivalent to 46.7% of the population of Alberta. Approximately 68% of the study area population is located within the Bow River Basin.

The 1996 study area population showed an annual growth rate of 1.70% in the 1991-1996 inter-censal period. As indicated in the summary table below, annual growth rates differed appreciably among the four basins. The Bow River Basin led with 1.92% annual growth; this was followed by the South Saskatchewan and the Red Deer Basins at 1.48% and 1.45% respectively. Population growth was lowest in the Oldman River Basin, at an annual rate of 0.89%.

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| DRAWN | Gary Evenson |
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## STATISTICS CANADA CENSUS DIVISIONS IN THE STUDY AREA

Figure 2-1

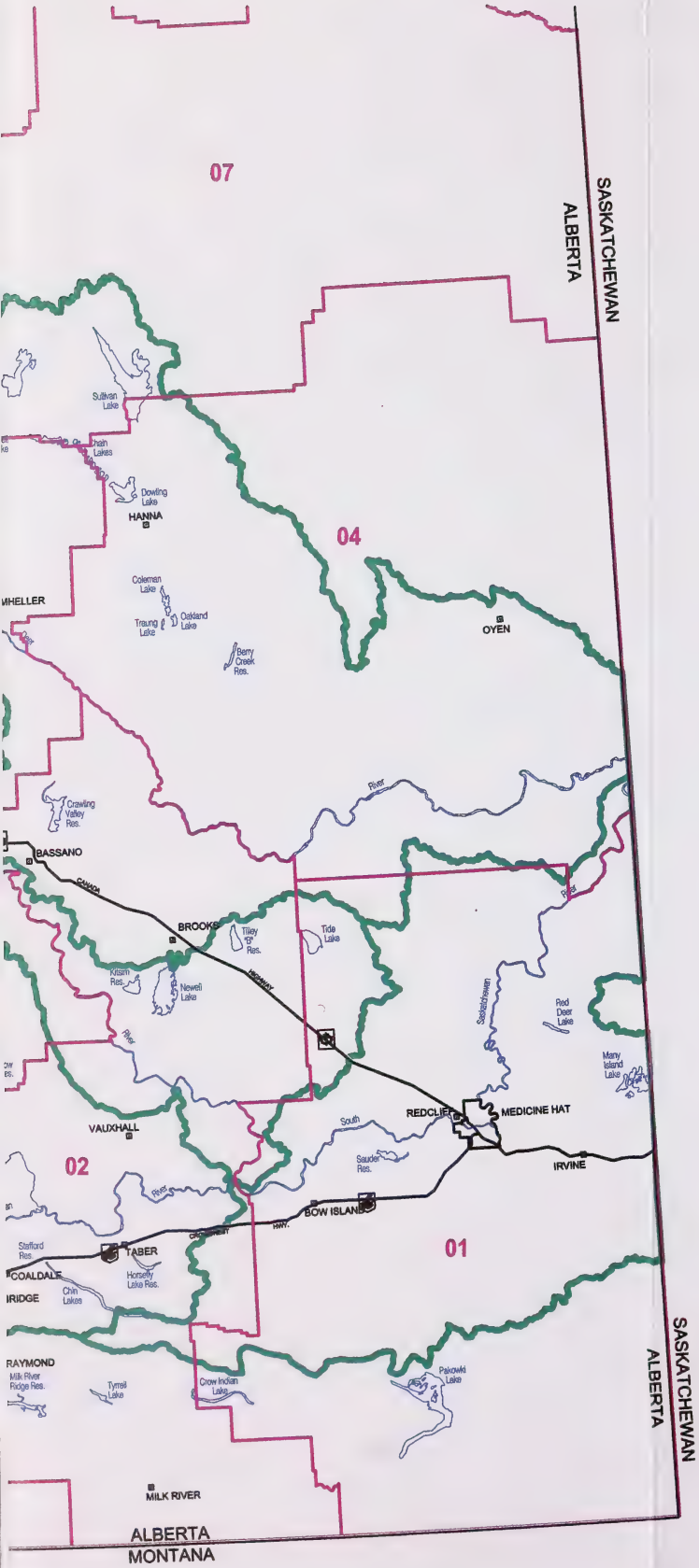


**Table 2.1**
**Distribution of 1996 Population and Population Growth Rate among Basins**

| Basin | 1996 Population | 1991-1996 % annual change | Comments |
|---|---|---|---|
| Red Deer River | 206,538 | 1.45% | Sub-basins have annual growth rates between 1.13% and 2.31% |
| Bow River | 878,387 | 1.92% | Sub-basins have annual growth rates between 1.36% and 6.26% |
| Oldman River | 152,031 | 0.89% | Sub-basins have annual growth rates between 0.46% and 2.21% |
| South Saskatchewan River | 60,192 | 1.48% | The two sub-basins have annual growth rates of 1.48% and 1.51% |
| SSRB Total | 1,297,147 | 1.70% | |

**Figure 2-2**
**1996 Population Distribution**

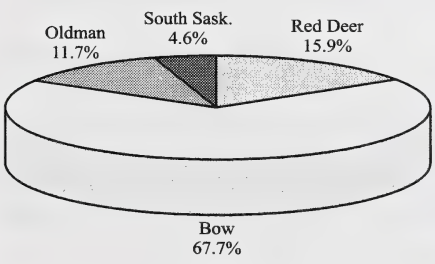
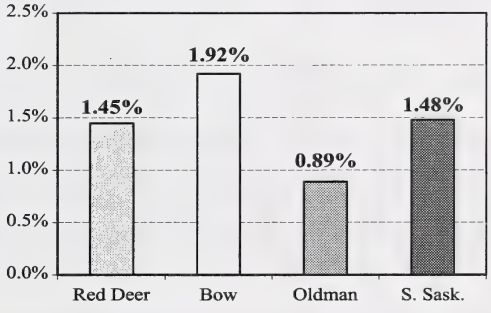



**Figure 2-3**
**1991-1996 Annual Change in Population**




Population growth was slightly lower in the study area for 1991-1996 (1.70% annually), than during the 1986-1991 inter-censal period when it was 1.85% annually. This was due in large part to slower growth rates in the cities of Calgary, Red Deer and Lethbridge. However, the data show the opposite trend in many rural areas. Census Sub-Divisions registering negative growth rates in 1991-1996 numbered approximately one-half of those losing population in the 1986-1991. This phenomenon has been described as a quiet "renaissance" taking place in small communities throughout Alberta (Chambers and Deans, 1998).

## 2.2 CHARACTERIZATION OF ECONOMIC ACTIVITY

The study area has an extraordinarily varied mix of economic activity. It can be characterized briefly as follows:

*Red Deer River Basin*

This basin encompasses extreme geographic diversity, from the front range of the Rocky Mountains to the rolling parkland around Red Deer to the relatively flat grasslands adjacent to the Saskatchewan border.

Economic activity includes forestry in the foothills, crop and livestock agriculture (ranching, intensive livestock operations, grains and oilseeds and some irrigated acreage), oil and gas (including large scale petrochemical facilities at Joffre), and recreation and tourism (e.g., in the lakes country at Sylvan Lake and in the badlands at Drumheller and further east at Dinosaur Provincial Park). Red Deer is an important service and industrial centre that benefits from its location midway between Calgary and Edmonton.

*Bow River Basin*

The Bow River Basin stretches from the continental divide (in Banff National Park) through the foothills and out onto the plains, reaching well inside the semi-arid southeastern portion of the province.

Much of the basin forms the hinterland of Calgary. It is the most densely populated area of Alberta. Originally associated primarily with agriculture and oil and gas, the city's economic base has diversified and become home to many corporate head offices, manufacturing concerns, service providers, recreational facilities and centres of higher education. Some residents of the nearby centres such as the City of Airdrie and the towns of Cochrane, Okotoks, Strathmore and other towns and villages travel to work in Calgary. There is also a rapid growth in employment sources outside Calgary.

The scenery and recreation facilities in the Rocky Mountains attract large numbers of tourists. Agriculture is diversified, with ranching being important in the foothills and grains and oilseeds dominating further east. There is also substantial irrigated acreage. The basin includes quite extensive oil and gas production.

*Oldman River Basin*

This basin extends from the continental divide (in the Crowsnest Pass and Waterton Lakes National Park) out onto the plains east of Lethbridge.

The primary economic activity is agriculture and value-added processing. Intensive livestock production has given the area around Lethbridge the moniker "feedlot alley." There are substantial areas under irrigated crops including vegetables. The City of Lethbridge is a major service and higher education centre for much of southern Alberta,

and it is a hub for inter-provincial and north-south transportation routes. Tourism is important in the National Park and at several other sites. Oil and gas production is also present.

*South Saskatchewan River*

This sub-basin of relatively flat land lies downstream of the confluence of the Bow and Oldman Rivers. It is close to the Saskatchewan border and comprises the driest and some of the least inhabited areas of southern Alberta. The City of Medicine Hat is a key transportation hub and service centre for the natural gas industry.

*Regional Growth Patterns*

Construction projects lying within the study area have been extracted from the lists prepared by Alberta Economic Development and summarized in Table D2. The list shows that as of November 2000, there were 675 projects that were recently completed or under construction or proposed within the CDs that comprise the bulk of the study area. By value, 52% of the total was situated in CD 6 (Calgary) and 26% in CD 8 (Red Deer).

Table 2 also indicates the top three categories of construction projects. No fewer than eleven different sectors of activity are featured in the table, led by Infrastructure and Agriculture & Related, and followed by Power, Commercial/Retail, Tourism and Institutional. Other sectors appearing in the list are Oil & Gas, Chemicals & Petrochemicals, Forestry & Related, Pipelines and Other Industrial.

## 2.3 LIVESTOCK INVENTORIES

Data were compiled on livestock numbers for each of the rural municipalities from the Statistics Canada Census of Agriculture of 1981, 1986, 1991 and 1996. The numbers presented in Table D3 are the totals for each municipality. Sub-basin estimates for 1996 livestock numbers based on the area ratios used for the rural human population splits are shown in Table 2.2.

The four species descriptors considered were "cattle and calves," "pigs," "sheep and lambs" and "hens and chickens." Due to seasonal fluctuations, livestock inventory numbers should ideally be based on the same calendar date each census year to be comparable. For 1981, 1986 and 1991, the data were collected on June 3 or 4. However, the 1996 data (as an economy measure) were collected on May 14.

The livestock inventories suggest steady growth in cattle and calves in almost every municipality between 1991 and 1996, with the growth being substantial in municipalities that already have feedlots (Table D3). Whereas cow-calf operations tend to be located in areas of more marginal land where forages predominate, feedlots tend to be located in grain growing areas and where land is suitable for growing good silage crops. The County of Lethbridge No. 26 exhibited the greatest growth in cattle, with an 80% increase between 1991 and 1996. The County of Vulcan No. 2 and M.D. of Foothills No.

31 registered 69% and 59% increases. The County of Lethbridge No. 26 had 84% more cattle than the next ranking municipality (County of Newell No. 4).

**Table 2.2 Estimated 1996 Livestock Populations by Sub-basin**

| Basin | Sub-basin | Cattle & Calves | Pigs | Sheep & Lambs | Hens & Chicks |
|---|---|---|---|---|---|
| | RD1 | 74,399 | 17,839 | 2,946 | 62,992 |
| Red | RD2 | 226,413 | 95,729 | 9,937 | 164,847 |
| Deer | RD3 | 192,377 | 86,593 | 7,615 | 188,231 |
| River | RD4 | 127,627 | 94,645 | 5,272 | 162,686 |
| | RD5 | 383,375 | 212,760 | 14,790 | 1,177,274 |
| | RD6 | 259,772 | 47,521 | 5,475 | 169,711 |
| | Sub-total | 1,263,963 | 555,088 | 46,035 | 1,925,741 |
| | B1 | 12,790 | 1,800 | 1,240 | 3,540 |
| Bow | B2 | 28,619 | 5,079 | 1,217 | 33,353 |
| River | B3 | 22,435 | 4,023 | 964 | 26,410 |
| | B4 | 33,809 | 3,297 | 1,699 | 73,171 |
| | B5 | 13,153 | 2,043 | 687 | 25,852 |
| | B6 | 91,702 | 30,072 | 5,459 | 144,731 |
| | B7 | 138,149 | 35,906 | 4,075 | 101,758 |
| | Elbow | 114,811 | 8,886 | 6,600 | 271,123 |
| | Highwood | 7,448 | 1,350 | 930 | 2,555 |
| | Sub-total | 462,915 | 92,455 | 22,870 | 682,495 |
| | O1 | 91,588 | 7,185 | 4,493 | 76,217 |
| Oldman | O2 | 95,042 | 20,336 | 5,605 | 141,610 |
| River | O3 | 118,202 | 33,706 | 5,799 | 273,368 |
| | O4 | 190,225 | 82,625 | 10,220 | 285,827 |
| | Waterton | 54,979 | 9,905 | 3,882 | 55,608 |
| | Belly | 25,875 | 9,123 | 3,062 | 29,092 |
| | St. Mary | 139,536 | 61,879 | 10,722 | 255,552 |
| | Willow | 70,102 | 12,850 | 4,143 | 71,974 |
| | Little Bow | 253,341 | 60,557 | 13,524 | 477,914 |
| | Sub-total | 1,038,890 | 298,165 | 61,449 | 1,667,162 |
| South | SS1 | 98,694 | 38,282 | 3,172 | 95,631 |
| Sask. | SS2 | 55,445 | 9,982 | 1,243 | 11,160 |
| | Sub-total | 154,139 | 48,264 | 4,415 | 106,790 |
| SSRB | TOTAL | 2,919,907 | 993,971 | 134,769 | 4,382,188 |

(1) Based on populations in Table D3 by County/MD prorated on the percentage area within each SSRB sub-basin.

The data for pigs show less significant increases between 1991 and 1996 than in previous periods. In fact, absolute numbers declined in several municipalities. Growth seemed to be fairly steady in the three municipalities with the greatest number of pigs, the County of Lacombe No. 14, County of Lethbridge No. 26 and Kneehill County No. 48. The M.D. of Taber No. 14 experienced a 95% growth in pig numbers in the 1991-1996 period. The Counties of Lethbridge and Red Deer had the highest pig densities in the province, respectively at 35 and 16 pigs per $km^2$ of arable land (Golder Associates, 1999, p.2-3).
A clear trend in sheep and lambs was hard to identify. The data show small numbers and extreme variability. The County of Lethbridge No. 26 was the leading municipality in absolute numbers.

Hens and chickens also showed variability in totals between one census and the next. The County of Lethbridge No. 26 led the way with the largest poultry inventory. The M.D. of Kneehills No. 48 came a close second. The County of Ponoka No. 3, with a relatively small inventory, registered a 225% increase between 1991 and 1996.

Clearly, the study area does encompass intensive operations in cattle, pigs and poultry, and it would appear that the size of such operations is increasing.

# 3.0 CURRENT WATER USE

## 3.1 WATER USE CATEGORIES AND LICENCES

Types of water uses or categories are identified according to use descriptors applied in AENV's licence file lists. The major categories used in this study are: Stockwatering, Other (non-irrigation) Agriculture, Municipal, Industrial and Water Management. For clarity, non-irrigation agriculture was divided into "Stockwatering" and "Other Agriculture" – feedlots, fish farms, market gardens and tree farms plus wetlands, parks and golf courses (see discussion below for the basis of the grouping of the sub-categories).

The term "Municipal" signifies licences held by cities, towns and villages and other uses such as households, schools, institutions, recreation facilities, camps, sub-divisions and water cooperatives that would normally be served by municipal water supply systems. Municipal use includes supply to industrial and other non-residential users that can account for up to 50% of total municipal use. Rural household use is included in the municipal category.

"Industrial" licences encompass uses such as aggregate washing, construction, oil and gas processing and injection, petrochemicals and food processing. Hydropower does not have any estimated consumptive use in the AENV license files and is, therefore, excluded from this study.

The "Water Management" category includes licences dealing with flood control and stabilization, as well as drainage and "remediation" projects. Although wetlands might best be included in this category, the AENV files usually listed this descriptor under the agricultural heading.

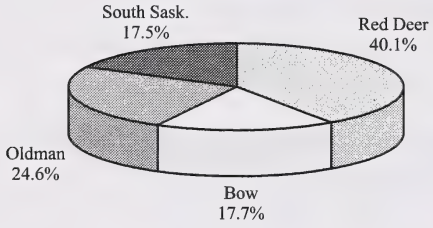
There are differences in the application of AENV's water use codes between the various offices. Some of these are as follows:

- The "Fish" descriptor normally means fish farms but occasionally includes water management measures for in-stream fisheries.
- "Golf courses" are listed in this study under "Other Agriculture," because this category is the one primarily used in the AENV files. However, golf courses are also listed in the license files under the "Recreation" use in the "Municipal" category.
- "Recreation" usually consists of hotels, motels, resorts, camps and parks but may also include in-stream management measures for recreation/conservation purposes.
- "Feedlots" were broken out and included as a separate sub-category under "Other Agriculture" where they were specifically coded as such in the files. However, in many cases it is expected feedlots and other intensive livestock operations were coded and are included under "Stockwatering".

The above differences in coding were not individually sorted in this study because of the intensive manual effort that would be required and because they only affected a small amount of consumptive use.

Table D4 summarizes the number of non-irrigation licence files, compiled by AENV. In 1996 there were 10,181 water licences or interim licences for withdrawals in the study area. Over the past ten years the number of water licenses increased by about 360/year from 1989 to 1995, by 158/year from 1995-98 and by 60 in 1999. The licences are distributed among the four basins of the SSRB and by major use category as shown in Figures 3-1 and 3-2 below.

**Figure 3-1**
**Distribution of 10,181 Water Licences**



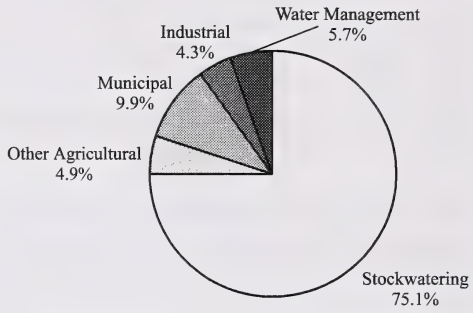




**Figure 3-2**
**No. of Water Licences by Category**

The largest number of licences (40.1%) fall within the Red Deer basin and three-quarters of all licences are for stockwatering. The predominance of stockwatering licences is noteworthy. These are usually for small reservoirs located on minor tributaries, and typically require 1 to 5 acre-feet (1.2 to 6.2 $dam^3$) annually for stock but have larger withdrawals to replenish water that is consumed and to offset losses due to evaporation and seepage. According to AENV, several older licences for household use are included in the stockwatering classification.

Tables D5a through D5e summarize the key data provided in the licence documents up to 1996, i.e., licenced withdrawal or maximum annual diversion (MAD), expected consumption (CONS), losses and return flow. The tables describe the volumes allocated for major uses in each river basin and sub-basin. It should be noted these tables do not account for transfers of water between sub-basins as the license data are assigned only to the source basin. Based on Table D5e, the total non-irrigation water use (in thousand $dam^3$) in the basin is as follows:

$$MAD = CONS + LOSSES + RETURNS$$
$$1256 = 366 + 216 + 674$$

Table D6 summarizes expected consumptive uses based on AENV licences recorded in 1996. In this table, consumptive use is defined as withdrawals minus return flows based on estimates in licence files. The leading consumptive uses in the SSRB based on the licences are shown to be industrial, followed by municipal and then water management. Expected non-irrigation consumptive use is 30% in the Red Deer, 36% in the Bow, 27% in the Oldman and 7% in the South Saskatchewan portion of the SSRB.

## 3.2 MUNICIPAL WATER USE

### 3.2.1 Data Sources

Data sources for actual municipal water use were the questionnaire responses and water treatment plant and wastewater treatment plant reports submitted to AENV. The available results for the major centres of population are summarized in Table D7 for three time periods: an average for 1990-93, an average for 1994-96 and an average for 1997-99. In some instances, table entries were computed on the basis of fewer years of data than indicated in the column header because of missing data.

The major municipal water users are the cities of Calgary (which also supplies Airdrie), Red Deer, Lethbridge and Medicine Hat. Other sizable municipal systems include the Mountain View Regional System that supplies six towns - Innisfail, Olds, Crossfield, Carstairs, Bowden, and Didsbury plus other industrial and municipal demands and the Henry Kroeger System that is a wholesaler to Hanna, Oyen, Delia, Youngstown, Cereal, Craigmyle, and various hamlets and farms.

### 3.2.2 Per Capita Municipal Use

Municipal per capita withdrawals and consumptive use vary widely among municipalities because of infrastructure design, location in the basin and the amount of water provided to other uses. In the 1997-99 period, withdrawal per capita ranged from less than 100 to over 500 $m^3$/person/year in the villages, towns and cities in the basin (this equates to 274 to over 1370 litres/person/day using the more common municipal rate term). Consumptive use values in Table D7 ranged from negative, because of sewer infiltration and storm sewer connections, up to 370 $m^3$/person/year and averaged 135 $m^3$/person/year.

Per capita withdrawal and consumptive use rates over the major basins are illustrated in Table 3.1 below. Use is higher in the drier southern portion of the basin because of higher evaporative losses and greater reliance upon storage systems that have higher evaporative and seepage losses associated with them. Per capita consumptive use is low in the Bow basin because of the low per capita consumptive use values for Calgary (<30 $m^3$/person/year) that are more typical in a large city.

**Table 3.1**
**Average Municipal Per Capita Water Use from Questionnaires (1997-99)**

| Basin | Withdrawal ($m^3$/person/year) | Consumptive Use ($m^3$/person/year) |
|---|---|---|
| Red Deer | 149 | 60 |
| Bow | 220 | 56 |
| Oldman | 308 | 181 |
| South Saskatchewan | 332 | 205 |
| SSRB Total | 212 | 126 |

By way of comparison, municipal domestic water use in Canada is approximately 131 $m^3$/person/year and 107 $m^3$/person/year in Alberta (1983 data including a prorated portion of losses/unaccounted - D. M. Tate, 1990). Tate reports residential water use is 40% of the total municipal withdrawals (45.3% in Alberta), commercial/institutional is 16%, industrial is 18% and losses/unaccounted is 26%. Therefore, the Canadian average total municipal withdrawal rate would be approximately 242 $m^3$/person/year and 216 $m^3$/person/year in Alberta. The SSRB average above is about 88% of this 1983 national average and 98% of the Alberta value.

Canadian municipal return flows, defined as the measured intake to waste treatment facilities, averaged 61% of withdrawals (the balance is consumed, lost by leakage or released untreated, Tate and Lacelle, 1987). The estimated municipal average in the SSRB, by comparison, is highly variable from 0 to over 100% but averages about the same as this national average.

### 3.2.3 Village and Rural Household Use

In addition to the municipal uses listed in Table D7, rural and village use data were obtained from the various municipal districts, counties and irrigation districts based on the questionnaire returns. Data from another 11 villages, 5 farm co-ops and 4 country residential co-ops were obtained from AENV files. Available records from AENV files were primarily limited to pre-1995 because of AENV's policy change to not enforce reporting of water consumption. Withdrawals from these rural sources ranged from 100 to 350 $m^3$/person/year and averaged about 200 $m^3$/person/year (542 litres/person/day). Again, per capita water use was much higher in the southern villages and rural areas where evaporation is higher and diversions from canals to storage reservoirs is common. Typical per capita withdrawals based on the data are as follows:

| | |
|---|---|
| Oldman and southern Bow villages | 204 $m^3$/person/year |
| Country residential co-ops | 180 $m^3$/person/year |
| Farm co-ops | 187 to 410 $m^3$/person/year |

For the villages and rural areas for which water use data could not be obtained, estimates of actual use were based on available per capita usage rates from similar nearby jurisdictions. Assumed village/rural withdrawal values ranged from 150 to 200

$m^3$/person/year with consumptive use ranging from 75 to 140 $m^3$/person/year. The higher values were usually applied in the south and lower values were typically applied for the less developed rural areas.

The above accounting of village/rural water use is assumed to incorporate the statutory right of rural households to annually withdraw up to 1 acre-foot (1.2 $dam^3$) for household purposes without a licence. For comparison purposes only, another means of quantifying rural household use is based on AENV Water Sciences Branch water well records. These records indicated that there are approximately 92,300 household wells within the SSRB study area. It is estimated that another one-third of this total are not on record. Assuming 25% of all wells are functioning or about 30,000 wells, and that the average consumption per well is at least 0.25 an acre-foot per year, the total rural household water consumption in the SSRB is estimated at 7,500 acre-ft per year or approximately 10,000 $dam^3$/year. At a per capita use rate of 100 $m^3$/person/year, this rate is equivalent to supplying over 60% of the estimated 1996 rural population of 159,000 in the SSRB that are not listed under a specific city, town or village in Table D1.

### 3.2.4 Sub-Basin Transfers

Numerous instances of municipal transfers between sub-basins occur where water is piped or conveyed by canal to another sub-basin. A summary of the major municipal sub-basin transfers or use transfers within sub-basins is listed in Table 3.2 below. These transfers are accounted for in the municipal use calculations in this study.

A number of other minor sub-basin transfers have not been identified and accounted for in the use totals. Such transfers occur through hauling treated water, and the piping of water out to nearby water co-operatives and other rural users. The implementation of the Water Act on January 1, 1999, combined with licence holders' concerns over the quality of groundwater in some parts of the study area may reduce reliance by rural residents on wells. There may be a corresponding increase in hauling of treated water from municipally run pay-as-you-go hauling stations.

**Table 3.2**
**Summary of Municipal Flow Transfers and Accounting of Sources or Returns**

| Main Sub-Basin | Minor Sub-Basin | Name | Sub-Basin Transfer Notes | Withdrawal (MAD) | Return |
|---|---|---|---|---|---|
| Red Deer River | RD2 | Crossfield | Irrigation and some returns | RD2 | B3 |
| | RD2 | Carstairs | Mtnview. System to Rosebud R. | RD2 | RD5 |
| | RD2 | Didsbury | Mtnview. System to Rosebud R. | RD2 | RD5 |
| | RD2 | Penhold | Returns to City of Red Deer | RD2 | - |
| | RD5 | Cereal | in RD6 moved to RD5 | RD5 | RD6 |
| | RD5 | Munson | no return – evaporation | RD5 | - |
| | RD5 | Oyen | Returns to RD6 | RD5 | RD6 |
| Bow River | B2 | Cochrane | Returns to Calgary system | B2 | B3 |
| | B3 | Airdrie | CONS & Returns to Calgary | - | - |
| | B3 | Calgary | 40% Elbow CONS, return to B3 | B3/Elbow | B3 |
| | B3 | Chestermere | CONS & Returns to Calgary | - | - |
| | B4 | Strathmore | From WID, no return – irrigation | B3 | - |
| | B5 | Vauxhall | BRID CONS | B5 | O4 |
| | B6 | Gleichen | WID source | B3 | B6 |
| | B6 | Bassano | B6 CONS, return to RD6 | B6 | RD6 |
| | B6 | Brooks | B6 CONS, return to RD6 | B6 | RD6 |
| | B6 | Duchess | B6 CONS, return to RD6 | B6 | RD6 |
| | Highwood | High River | Return to LBR in Frank L, evap. | Highwood | LBR |
| Oldman River | Belly | Hillspring | MAD via UID | Belly | Belly |
| | LBR | Vulcan | MAD from LBR, no returns | LBR | - |
| | LBR | Barons | no return – evap. or irrigation | O2 | - |
| | LBR | Blackie | Return to Frank Lake | Highwood | LBR |
| | LBR | Milo | From MacGregor Lake | B5 | B6 |
| | O1 | Pincher Creek | No return – evap or irrigation | O1 | - |
| | O3 | Coaldale | MAD via Lethbridge now, was SM, 100 $dam^3$ irrigation return | O3 | O4 |
| | O3 | Picture Butte | Returns to O3 | O2 | O3 |
| | ST-M | Barnwell | MAD via TID | St M | O4 |
| | ST-M | Cardston | MAD from Lee Creek | St M | SM |
| | ST-M | Magrath | Returns to Pothole Creek | St M | SM |
| | ST-M | Taber | MAD via SMRID | St M | O4 |
| | ST-M-SUB | Raymond | MAD via St. Mary Headworks | St M | St M Sub |
| | WAT | Glenwood | MAD via UID | Belly | Belly |
| | Willow | Claresholm | no return – evap or irrigation | Willow | - |
| | Willow | Granum | no return – evap or irrigation | Willow | - |
| South Sask. River | SS1 | Bow Island | MAD via SMRID, no return evap. | St M | - |
| | SS1 | Medicine Hat | Some irrigation and DU and oilfield effluent use | SS1 | SS1 |
| | SS1 | Redcliff | Return to Medicine Hat | SS1 | - |

### 3.2.5 Actual Use Calculations

Actual municipal use was computed by sub-basin based on the per capita rates discussed above applied to each population identified in Table 1. This computation is assumed to account for all municipal uses except recreation, camps and schools. Actual use in these

sub-categories was assumed to be equal to 80% of the licenced allocation as an average annual value.

In this calculation not all of the effluent released by wastewater treatment plants is counted as return flow. In summer months, some of the effluent is transported for uses such as irrigation of golf courses, tree farms and hay crops. Amounts vary from year to year depending primarily upon summer precipitation. In other locations, effluent is directed to lagoons or wetlands. For instance, the Frank Lake Project uses return flows from the Town of High River and the Cargill meat packing plant that are piped to Frank Lake. The project also encompasses a wetland licence held by Ducks Unlimited (DU) which allows the transfer of up to 2,467 $dam^3$ from the Highwood basin to maintain the waterfowl habitat and aesthetic value of the Frank Lake wetland. Several instances where return effluent flows are reduced to zero or near zero by irrigation and/or evaporation are also listed in the above inter-basin transfer summary. These irrigation and evaporation amounts are treated as consumptive uses in the municipality in this report, or, in the case of a stabilization license, attributed to that use.

In addition, it should be noted that municipal effluent flows are not necessarily equal to return flows in this study because wastewater treatment plant flows may actually be higher than return flows indicated in the equation MAD=CONS+Losses+Return. This is because of stormwater runoff, groundwater infiltration or additional effluent from other sources.

## 3.3 NON-MUNICIPAL WATER USE

Forms referred to as "water use returns" were the main source of information on actual water consumption for non-municipal users. Up until the mid-1990s, these forms were submitted annually to AENV by many holders of water licences as a condition of their licence, with the larger licence holders generally providing better quality data. AENV policy then changed concerning enforcement of the reporting provision contained in the licences. The provision rapidly fell into disuse and in newly issued licences the wording was changed from requiring the submission of annual reports to requiring the licensee to collect the necessary data in case it is requested for examination by AENV.

A review was conducted of 202 licence holder files containing water use returns for all or portions of the 1991-1999 period. Based on this information:

- licenced withdrawals usually exceed actual withdrawals;
- consumption estimates in license files usually exceeds actual consumption;
- the under-utilization of licenced withdrawals and estimated consumption varies between user categories; and
- the under-utilization of licenced withdrawals and estimated consumption for many user categories varies from one time-period to another.

Table 3.3 summarizes the findings of the review for each of the agricultural and industrial use categories. Assumed relationships (termed "water use factors") between licenced and actual withdrawals and licence estimates and actual consumption are shown for each use category.

**Table 3.3**
**Water Use Factors Based on Analysis of Water Use Records**

| Use Category | No. Of Lic. | Actual as % of Licenced MAD | Variation over 91-99 period | Assumed MAD use factor | Actual as % of Licence Estimate CONS | Variation over 91-99 period | Assumed CONS use factor |
|---|---|---|---|---|---|---|---|
| Stockwatering | 66 | 77% | Higher in 97-99 | 80% | 78% | Higher in 97-99 | 80% |
| Other Agric. – Fishery | 5 | 82% | * | 80% | 25% | * | 25% |
| Other Agric. – Golf Courses | 4 | 79% | * | 80% | 84% | * | 80% |
| Other Agric. – Gardens | 7 | 67% | Higher in 94-99 | 80% | 68% | Higher in 94-99 | 80% |
| Other Agric. – Parks | 29 | 68% | Trend unclear | 80% | 74% | Lower in 94-99 | 80% |
| Other Agric. – Wetlands | 4 | 68% | * | 80% | 87% | * | 80% |
| Aggregate Washing | 17 | 69% | Higher in 94-99 | 85% | 85% | Trend unclear | 85% |
| Industrial Processing | 5 | 46% | Higher in 94-99 | 65% | 32% | Trend unclear | 65% |
| Gas/Petroleum | 3 | 61% | Trend unclear | 65% | 72% | Trend unclear | 65% |
| Injection | 28 | 35% | Lower in 97-99 | 40% | 35% | Lower in 97-99 | 40% |
| Other Industrial | 34 | 64% | Lower in 94-99 | 65% | 71% | Lower in 94-99 | 65% |

Source: based on analysis of 202 licence files containing water use records.
Note: * unclear, due to small number of licences reviewed

The following guidelines were followed in establishing the assumed water use factors:

- The actual withdrawal and consumptive use factors were the same in many files. Therefore, the same factor was applied for both withdrawals and consumptive use in most cases, unless clear differences were evident from the records.

- A rounding up of the factors was applied considering the variability in the records and the low proportion of actual records available and used in this review.

- Where the number of files reviewed was limited, reliance upon data from other similar uses (e.g., industrial processing and gas/petroleum with other industrial) was applied to develop common factors.

- A simplification was applied to reduce the number of factors.

Many of the selected water use factors are reasonably high, at between 65% and 85%. For industrial processing, it was decided to use the water use factors evident for other industrial uses; a possible explanation for the low take-up on licenced volumes is that licences may have been obtained in anticipation of a move from single to multiple shifts.

Lower than expected withdrawals and consumption may be a reflection of relatively wet weather (in the case of most agricultural uses) or improved efficiencies in water usage (or recycling) for industrial uses.

Recorded injection water use is low at 35%. This is expected in the older licences as oil and gas fields become depleted and re-cycling increases. A slightly higher factor of 40% was assumed to account for the high variations in use observed. The observed water consumption factor of 25% for the fishery category was applied without adjustment because this factor appeared to be reasonably consistent.

A comparison of the available data for three-year periods (1991-93, 1994-96 and 1997-99) did not identify any general increases or decreases in water use factors. A longer, more representative period of wet and dry cycles may show some patterns. However, the limited data available, the study scope and the variability in use precluded further investigation.

Actual use data reviewed in the water management category were limited to the Frank Lake operational data and hydrologic experience with various water management projects in the basin. Actual water management use is expected to be highly variable from near zero to 100% - mainly depending upon wet and dry climatic periods. A conservative use factor of 80% was assumed to estimate actual water management use in the basin.

## 3.4 Stockwater and Other Traditional Water Uses

Other water uses not included in the licence files include the statutory rural household use and other agricultural uses that include a portion of stockwatering use and water for pesticide use. These are termed traditional agricultural water uses.

Rural household use was accounted for on a per capita basis as discussed in Section 3.2.3.

Total consumptive use by livestock in 1996 can be quantified based on the livestock populations in Table 2.2 times typical per capita consumption rates as summarized in Table 3.4 below.

**Table 3.4 Estimated Livestock Consumptive Use in SSRB – 1996**

| Livestock | 1996 Population in SSRB[1] | Average Consumption Rate[2] ($m^3$/head/year) | Total Consumption ($dam^3$) |
|---|---|---|---|
| Cattle & calves | 2,920,000 | 25 | 73,000 |
| Pigs | 994,000 | 6 | 5,964 |
| Sheep & lambs | 135,000 | 4 | 540 |
| Hens & Chickens | 4,382,000 | 0.11 | 482 |
| | | Total | 79,986 |

(1) Summary of numbers from Table 2.2.
(2) Source: Dugouts for Farm Water Supplies, PFRA.

A 5% increase in the above total is assumed to account for other livestock such as horses, turkeys bringing the total estimated consumptive use to 84,000 $dam^3$. By comparison, the total estimated consumptive use based on the licence data for stockwatering and feedlots combined amounts to 41,383 $dam^3$ plus losses of 36,525 $dam^3$ (see Table D5e). Based on this comparison, a large portion of actual stockwatering use is not licensed in the SSRB. Comparisons at the sub-basin level indicate significant variation between expected stockwatering consumption from the licences and estimated consumption based on the livestock numbers. To account for all stockwatering use, estimated actual stockwatering consumptive uses for 1996 in each sub-basin were based on the greater of 80% of the licenced uses or the consumptive uses based on the livestock numbers.

Water use for pesticide applications is estimated at 676 $dam^3$/year. This is based on estimated average application rates of 135 litres/ha for dryland and 280 litres/ha for irrigated land with 3,760,000 ha and 607,000 ha of dryland and irrigated land in the SSRB respectively. This minor quantity is ignored in the estimate of actual use in the SSRB.

## 3.5 Relationship Between Allocated And Actual Water Use

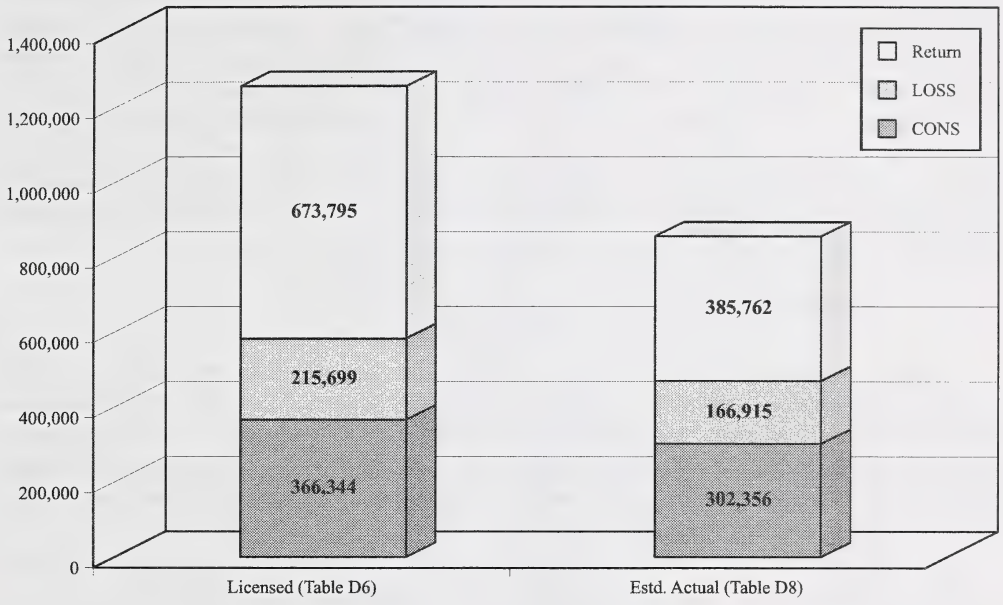
The municipal use rates identified in section 3.2, the actual use factors discussed in 3.3 above, and the stockwatering use in 3.4 above were used to estimate the actual use values summarized in Tables D8a through D8e. These tables are formatted in the same manner as Tables D5a through D5e, by river basin and major use category and indicate estimated actual withdrawals, consumption, losses and return flow. Thus, as an example, the estimated actual withdrawal (MAD) for industrial processing in the SSRB (31,833 $dam^3$) is 65% of the licenced withdrawal (48,974 $dam^3$).

The estimated actual water use for the SSRB can be summarized (in thousand $dam^3$) as follows:

MAD = CONS + LOSSES + RETURNS
854 = 302 + 166 + 386

The SSRB totals from tables D5e and D8e are compared in Figure 3-3 below.

**Figure 3-3**
**SSRB Licensed Versus Estimated Actual Water Use (dam³)**




## 3.6 SUMMARY OF ESTIMATED ACTUAL WATER CONSUMPTION

Table D9 presents a summary of estimated actual water consumption by river basin and major use categories. Its format is identical to that of Table D6, with consumption being defined as withdrawals minus return flows.

The leading consumptive uses in the SSRB when traditional stockwatering uses are included are now shown to be stockwatering, followed by industrial and then municipal. Also noteworthy is the variation among the river basins. Stockwatering is high in the Red Deer basin, accounting for 33.8% of estimated actual consumption in the basin. Municipal water consumption is especially high in the Bow (35.5%) and South Saskatchewan (38.8%) basins. Industrial water consumption is high in the Oldman basin where it accounts for 31.5% of the total.

The estimated actual withdrawals in Tables D8a through D8e and the estimated actual consumption in Table D9 form the two water-related variables upon which forecasts in Chapter 5 of this report are based.

The withdrawal and consumption analysis was repeated up to this point for the year 1999 in order to understand the pace of change within the period since the 1996 census. The base data for this exercise consisted of the master lists of licences for 1999 from the EMS database.

Table D10 indicates the percentage change by river basin and major use category between 1996 and 1999. Table D10 shows substantial variability in all four river basins and in sub-basins and use categories.

If one considers changes greater than 4% as noteworthy, the Red Deer basin has increases in stockwatering (in 1 sub-basin), in municipal (in 4 sub-basins) and in water management (1 sub-basin). The Bow River basin exhibits increases in other agriculture (3 sub-basins), municipal (5 sub-basins), industrial (1 sub-basin) and water management (1 sub-basin). The Oldman basin shows increases in stockwatering (2 sub-basins), other agriculture (1 sub-basin) and municipal (6 sub-basins). The South Saskatchewan shows increases in other agriculture (both sub-basins), municipal (1 sub-basin) and industrial (1 sub-basin). Also of note are decreases in municipal uses – in B3 and O3 due to lower water use in Calgary and Lethbridge in 1999 compared to 1996.

## 3.7 Seasonal Distribution Of Water Use

The data compiled to estimate actual annual water use, as discussed in the previous sections, were reviewed to document the monthly distribution of water use. The available data on withdrawals and consumption were plotted to define probable distribution patterns where these were evident. Consumption and withdrawal distribution plots were identical in nearly all instances. Sample distributions of withdrawals are summarized in Figures 3-4 and 3-5 for various use types.

Comments on seasonal variations in water use by use category are as follows:

| | |
|---|---|
| Stockwatering | varies from highly irregular (where reservoirs are filled) to uniform, most have no discernable monthly variation, some withdrawals limited to March to November (see Figure 3-4d) |
| Other agriculture | may be highly variable to uniform, assumed to resemble golf course distribution, main use is April to October, (3-4e & 3-4f) |
| Golf courses | use is from April to October, see Figure 3-4e |
| Oil and gas injection | typically, no discernable monthly variation |
| Aggregate washing | see Figure 3-4a, mostly concentrated in May to October |
| Other industrial | no discernable monthly variation, see Figure 3-4b and 3-4c |
| Municipal | see Figure 3-5 - sub-divided according to size, location and type of system. Major centres and cities are similar – Medicine Hat shows more seasonal variation than the other cities. Towns and villages that rely upon irrigation canals and storage have withdrawals mainly from May to October (e.g., Nobleford, Strathmore, Champion, Lamond, Donnelly, etc.). Other towns and villages are comparable to the major centres and cities. |

An assumed distribution of the estimated actual withdrawal and consumption values for 1996 based on the above review is presented for the SSRB as a whole in Figure 3-6. This distribution should be recognized as highly speculative and applied with caution. Individual sub-basin uses may be expected to vary substantially from this distribution. Based upon this distribution, non-irrigation water demand in the SSRB peaks in the month of June at nearly 100,000 $dam^3$ or 38.2 $m^3/s$ and reaches a minimum from November to February at approximately 19 $m^3/s$.

## 3.8 ANNUAL VARIATIONS

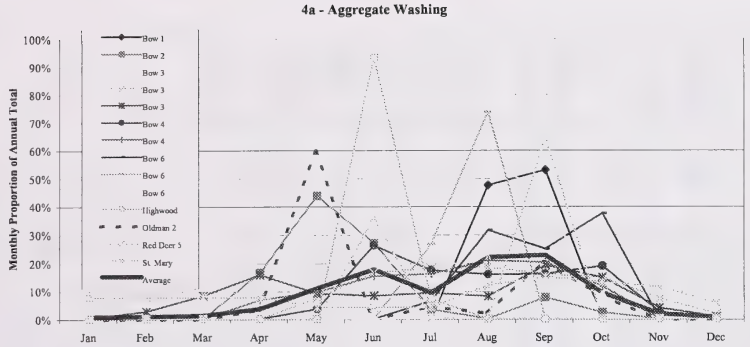
The estimated actual water use indicated above may be considered representative of mean annual conditions. Annual demand over the SSRB is highly variable depending upon location, wet/dry years and type of use. The available data from 1990 to 1999 were reviewed to assess the typical ranges of annual variations. This period is moderately short and does not represent extreme dry periods such as in the 1980's when actual use as a percentage of licensed allocation may have been much greater.

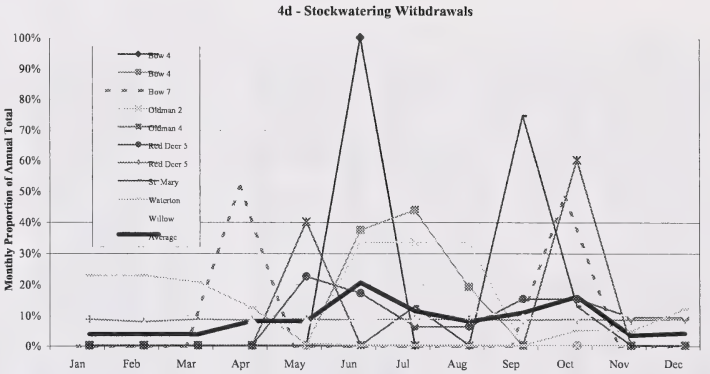
Annual irrigation use variations have been widely investigated based on long term climatic conditions and may be expected to range from ±40% from the mean (climatic data from 1912-82 from Kassem, Tate & Dorsett, 1994). Although irrigation use is not investigated in this study, this does provide an indication of variations in the other uses that are significantly affected by climate such as stockwatering, other agriculture and water management.

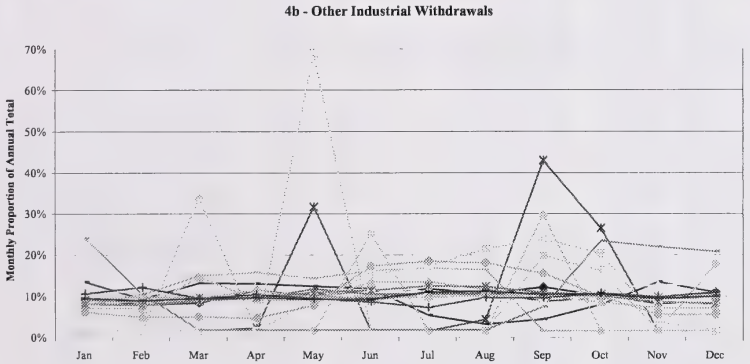
Annual municipal variations, accounting for population variations, can range ±20% with the greatest variations typically in the drier southeast portion of the basin such as Medicine Hat where lawn watering has a significant influence on annual fluctuations. The survey results recorded in excess of 50% in annual variations in some towns.

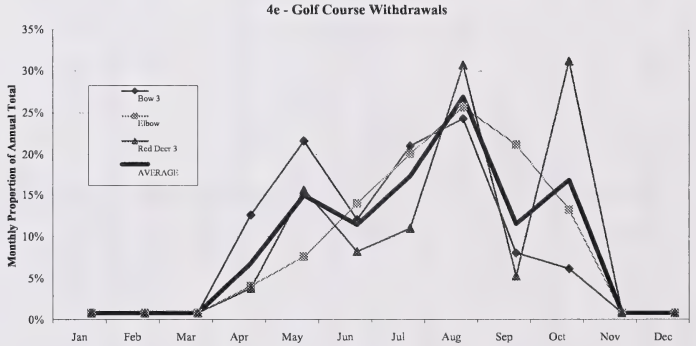
Industrial variations can be significant and highly unpredictable depending upon users, location and economic conditions. Over the SSRB as a whole actual annual variations, excluding growth factors, may be expected to vary by as much as ±30%.

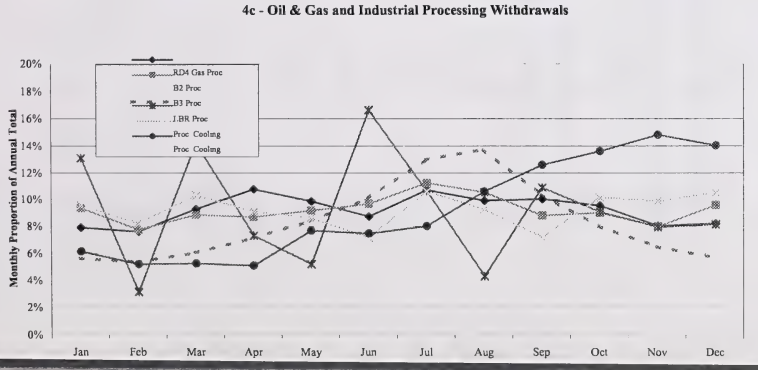
**Figure 3-4 Monthly Distribution of Withdrawals by Use Type**

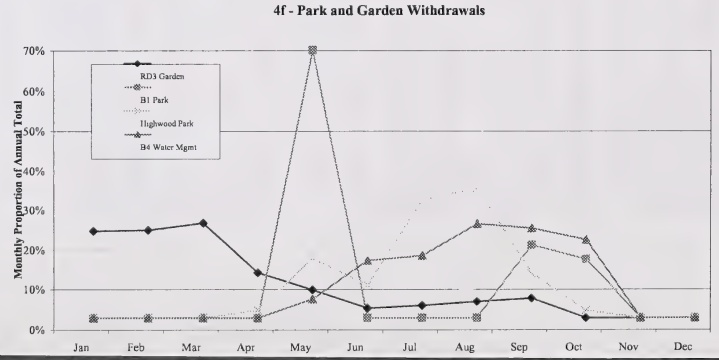


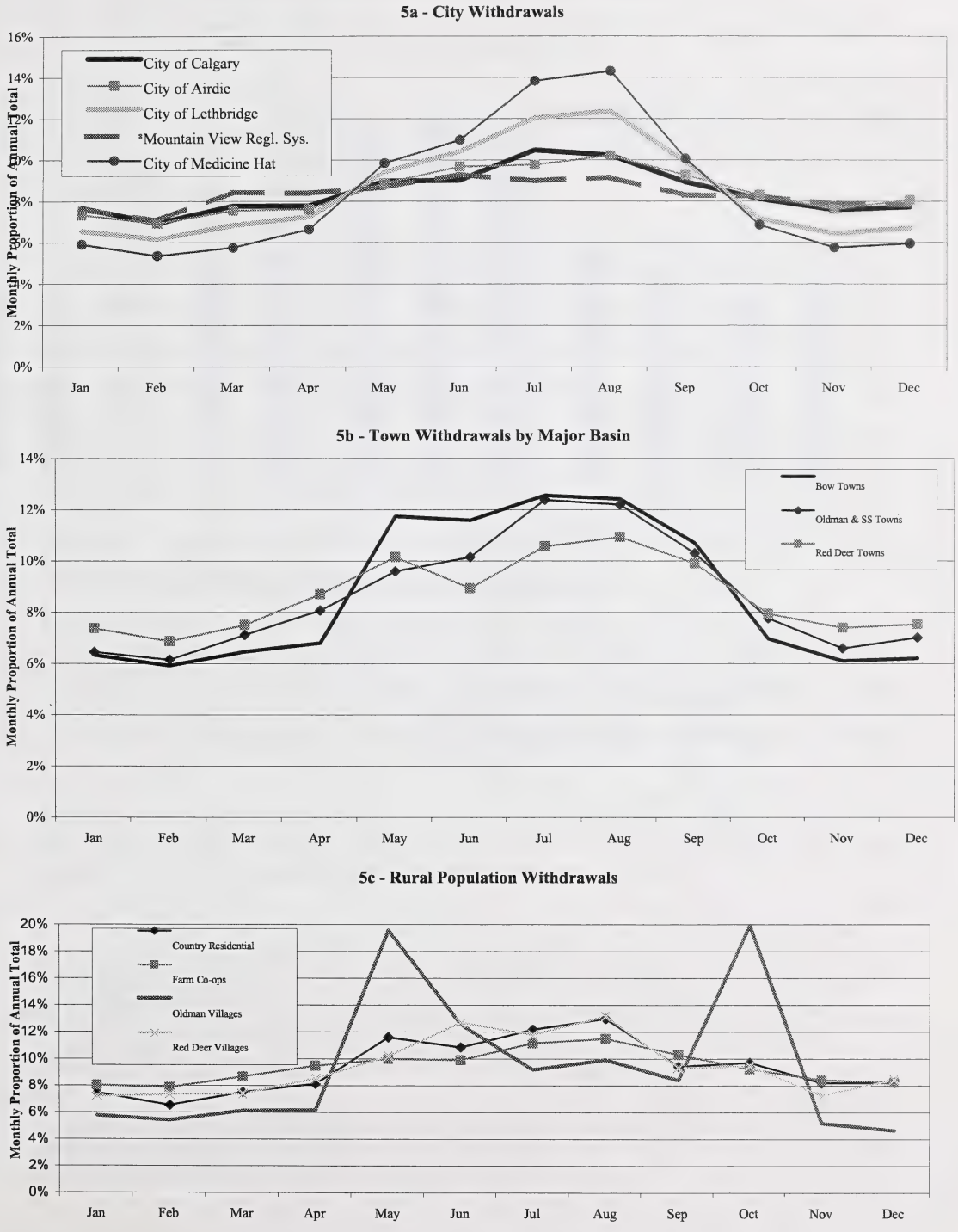



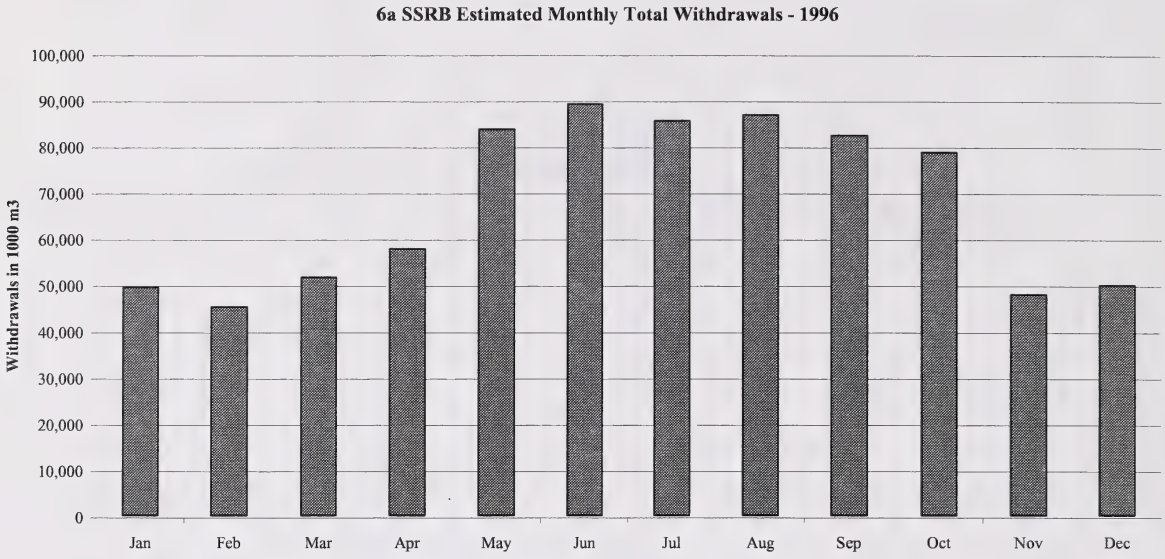



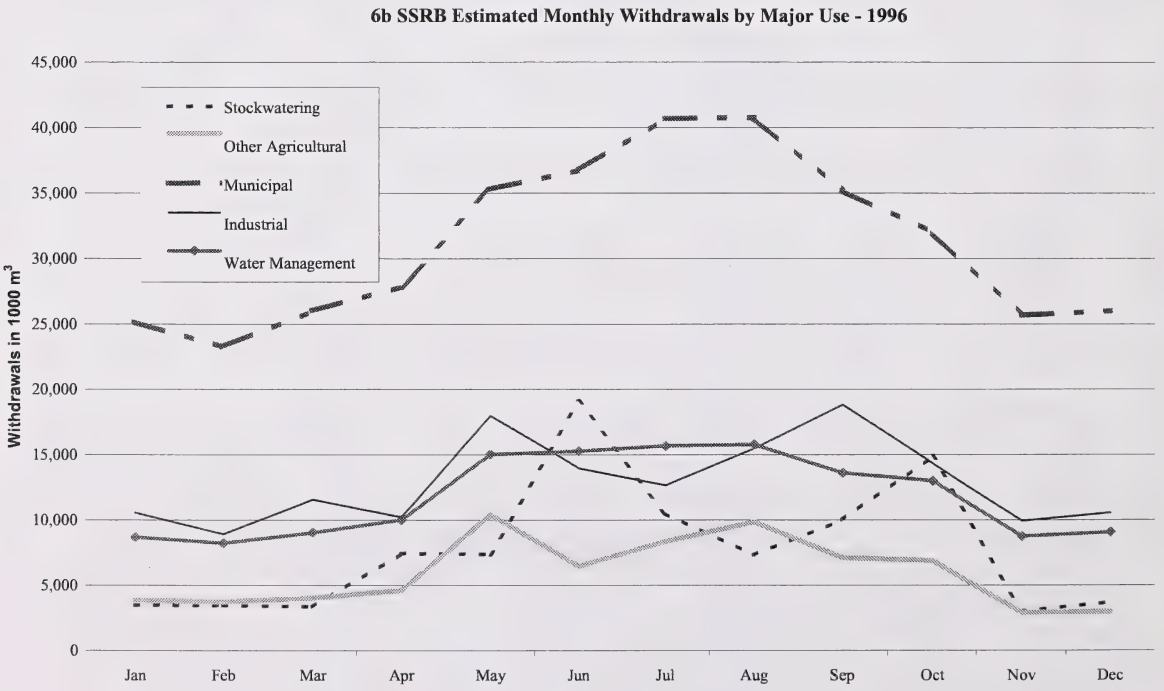



## Figure 3-5 Monthly Distribution of Municipal Withdrawals



## Figure 3-6 Estimated Monthly Distribution of Withdrawals in SSRB



# 4.0 FORECASTED POPULATION AND ECONOMIC ACTIVITY

## 4.1 THE APPROACH USED FOR FORECASTING POPULATION AND ECONOMIC ACTIVITY

This section of the report considers two separate sets of forecasts. The first deals with population at the level of river basins and sub-basins, the second with economic activity. Both sets of material provide necessary inputs for the task of forecasting water withdrawal and consumptive use in Chapter 5.

Populations were forecasted by means of the approximate component methodology, a methodology that is particularly suited for small-area analysis and long-range forecasts. The method involves a review of recent historical data and reputable population projections that are available for the study area. Growth rates for low, medium and high cases are then selected from among the compiled projections and used to extend the data series, in a straight-line fashion, to the desired time limit.

The procedure for deriving the population forecasts described in the following sub-sections has been scrutinized and commented upon by a professional demographer, Prof. Wayne McVey of the Population Research Laboratory of the University of Alberta (see Appendix E). Prof. McVey identified the uncertainties and limitations of long-range forecasts. His comments confirm that the estimates produced in this report must be considered as "ballpark" estimates.

Statistics Canada, Alberta Treasury and Alberta Health do not produce population forecasts beyond 2016 because they are not comfortable with longer projection periods. Professional demographers are conscious of the unreliability of long-term forecasts and point out the many unknowns which might significantly change underlying assumptions. (An excellent discussion of the different types of difficulty appears in the paper "Thirteen Ways of Looking at the Future" by Robert Bragg, 1997).

The Cities of Calgary, Red Deer and Lethbridge, as well as a handful of smaller municipalities, have prepared long-range projections but these would appear to be of varying quality and designed primarily for land annexation planning.

With respect to forecasting for small areas such as CDs, the greatest uncertainties attach to the migration component, not the mortality and fertility components. Economists at the City of Calgary, for instance, are having a tough time projecting where baby-boomers will choose to retire. The possible causal factors behind the "rural renaissance" – advances in communications technology and changes in lifestyle preferences – are making it much more problematic to adequately model migration flows.

The second half of this section forecasts future directions for economic growth within the study area. This information is needed for the forecasting of those future water use components that are not directly related to human population.

A number of information sources were used for background:

- Alberta Economic Development's listing of construction projects (Table D2);
- Alberta Environment's listing of applications for water licences (Table D13 described in Section 4.6);
- information presented by jurisdictions responding to the questionnaire; and
- the literature on growth in livestock populations.

A summary of the key factors influencing economic growth in the study area was then prepared to forecast significant (i.e., in terms of water demand) new economic activity occurring within the study area in the period prior to 2021 and 2046. As with the population forecasts, the forecasts of economic activity are "ballpark" estimates.

## 4.2 ALTERNATIVE POPULATION PROJECTIONS RELEVANT TO THE STUDY AREA

A number of existing population projections were compiled for jurisdictions within the study area. These are listed in the Table 4.1. Indicative population and percentage annual change numbers from these projections are compiled in Table D11.

Census estimates and existing population projections were compiled, to the extent possible, for the large cities and for CDs and health authority regions. For the projections which did not extend to 2046, simple averaging and smoothing rules were employed to complete the series. When graphed, the extended series in most cases appeared flat after 2016.

The percentage annual change numbers for the different projections were then graphed for each of the CDs, with the Alberta Health projections being shown for the nearest health authority region. In most CDs, there were a total of seven projections (three Statistics Canada, three Alberta Treasury and one Alberta Health); in a few CDs the number was higher because of the projections for major cities (Calgary, Calgary CMA, Red Deer and Lethbridge).

**Table 4.1 Existing Population Projections Relevant to the Study Area**

| Source | Areal unit | Years | Comments |
|---|---|---|---|
| Statistics Canada* – low growth | CD | Annually 2000-2016 | Prepared Sept. 1999 based on 1999 preliminary estimates |
| Statistics Canada* – medium growth | CD | Annually 2000-2016 | Prepared Sept. 1999 based on 1999 preliminary estimates |
| Statistics Canada* – high growth | CD | Annually 2000-2016 | Prepared Sept. 1999 based on 1999 preliminary estimates |
| Alberta Treasury – low growth | CD | Annually 1999-2016 | Prepared 1999 based on 1998 Alberta population estimates |
| Alberta Treasury – medium growth | CD | Annually 1999-2016 | Prepared 1999 based on 1998 Alberta population estimates |
| Alberta Treasury – high growth | CD | Annually 1999-2016 | Prepared 1999 based on 1998 Alberta population estimates |
| Alberta Health | Health authority region | Annually 1997-2001, 2006, 2011 and 2016 | prepared in 1998 based on the AHCIP Registry File; published scenario involves medium mortality, medium fertility and high migration assumptions |
| City of Calgary | City | Annually 2000-2051 | Prepared in August 2000 based on internal growth model |
| Calgary Census Metropolitan Area | Metropolitan area | Annually 2000-2051 | Prepared in August 2000 based on internal growth model |
| City of Red Deer | City | Annually 2000-2050 | Prepared as part of the City of Red Deer Growth Study |
| City of Lethbridge | City | 2000, 2010 and 2020 | Prepared as part of the Municipal Development Plan |
| Various smaller municipalities | Municipalities | Various, mostly very short-term | Mostly not based on rigorous projection techniques |

* Statistics Canada has discontinued the experimental program under which it provided customized population projections for Census Sub-Divisions.

## 4.3 Selection Of Growth Rates For Low, Medium And High Growth Cases

It was determined that in each CD, three projections appeared to provide a consensus view of growth. These were the Statscan Medium, Statscan High and Treasury High projections. The ordering of the three projections varied from CD to CD but typically the Statscan Medium represented the lowest growth scenario and the Treasury High represented the highest growth scenario.

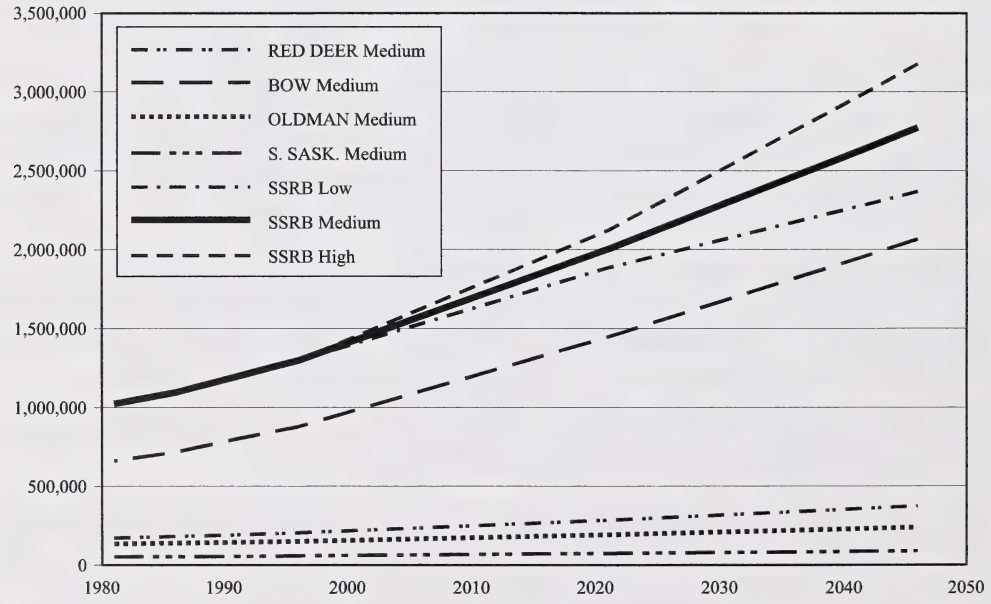
The Statistics Canada and Alberta Treasury projections anticipate a gradual lowering in Alberta's population growth rate. For example, for the Province of Alberta the Statistics

Canada medium growth projection decreases steadily from a 1.54% annual change in 2001 to 0.86% in 2006, 0.73% in 2011, 0.60% in 2016, 0.46% in 2021 and 0.35% in 2025. A breakdown of this particular projection is not available at the CD level.

Annual percentage change rates for the selected growth scenarios for each CD were then applied to the 1996 sub-basin population estimates. This exercise provided population forecasts for each of the sub-basins to 2046. For example, the post-2016 growth rates for the selected forecasts for CD6 (based on the three projections noted above) were used to calculate the high and low growth of population in sub-basins B2, B3, B4, Elbow and Highwood (in the Bow Basin) and sub-basin RD1 (in the Red Deer Basin) to the year 2046. Subsequently, the medium case was computed as the midpoint between the low and high cases.

No sub-basins were sufficiently well represented within CD 10 and CD 11 for the growth rates of those two CDs to be taken into account (the small portion of sub-basin RD4 which lies in CD 10 was provided with a growth rate from CD 7, and the small portion of sub-basin RD3 within CD11 was treated as if it were part of CD 8).

**Figure 4-1 Population Forecasts**




## 4.4 Forecasted Population By River Basin And Sub-Basin – Low, Medium And High Growth Cases

The population forecasts for each basin and sub-basin using the low, medium and high growth cases are summarized in Table D12. In Figure 4-1, the forecasts by sub-basin are plotted for the medium case only, with forecasts for the entire SSRB shown for the low, medium and high cases.

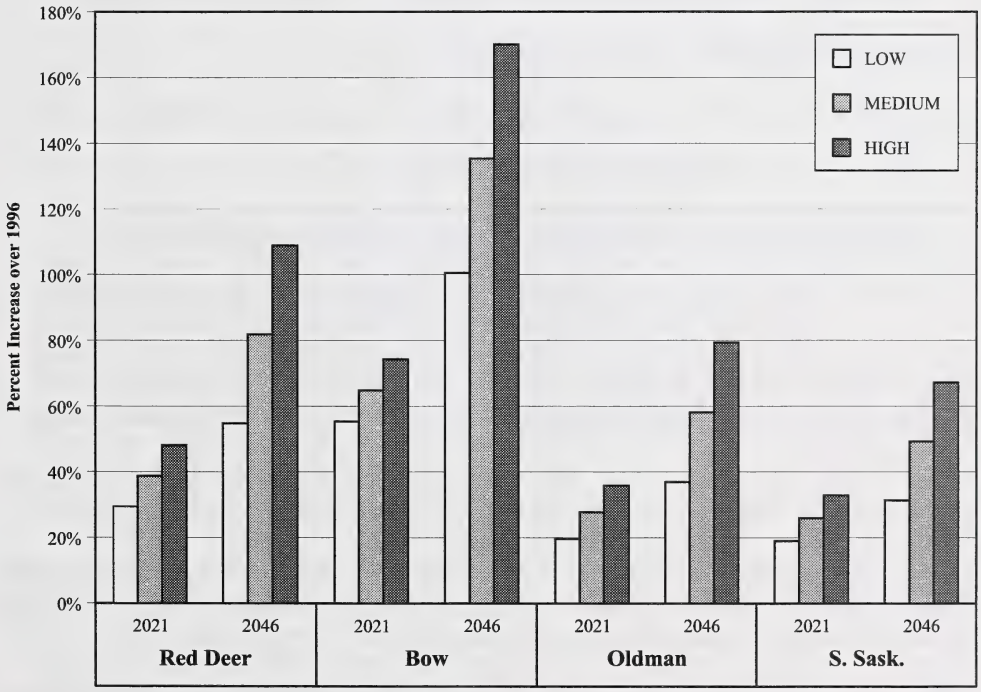
In the low case, the population for the SSRB is expected to reach 1.89 million in 2021, up 45% from 1996. In 2046, it is forecasted to be 2.37 million, up 83% from 1996.

The medium case sees the SSRB population increasing to 2.01 million in 2021, up 55% from 1996. In 2046, the basin total is forecasted to be 2.77 million, up 114% from 1996.

In the high case, the SSRB population is forecasted to climb to 2.12 million (up 64% from 1996) in 2021 and 3.18 million (up 145% from 1996) in 2046.

The forecasted percentage growth in each sub-basin is illustrated in Figure 4-2 below.

**Figure 4-2 Forecast Population Growth Rates by Sub-Basin**




## 4.5 INDICATIONS OF ECONOMIC ACTIVITY FROM LISTINGS OF CONSTRUCTION PROJECTS

The listing of construction projects in Table D2 provides an indication of current economic activity in each of the Census Divisions in the study area. A listing of proposed power plants obtained from the Alberta Energy and Utilities Board was also helpful.

Based on these sources, new water users can be expected in the following categories (examples of specific users are given in parentheses):

- infrastructure (highway construction/upgrading, waters reservoirs and canals, water treatment and sewerage plants, airport expansion)
- agricultural (intensive livestock operations, food processing plants, grain terminals, agricultural research facilities)
- power (natural gas power plants, expansion/upgrading of thermal power plants)
- commercial/retail (shopping malls, office buildings)
- tourism (hotel/resort complexes, conference centres, entertainment facilities)
- institutional (hospitals, educational facilities)
- oil and gas (oil batteries, gas plants, straddle plants, injection facilities)
- chemicals and petrochemicals (ethylene plants)
- forestry (modernization of saw mills, wood product manufacturing plants)
- pipelines (natural gas and oil trunk pipelines, small-diameter gathering systems)
- manufacturing and other industrial (light equipment manufacturing, cement plants)
- telecommunications (telecom component manufacturing, software manufacturers)

A few of the above – particularly those involving transportation infrastructure – require very little water withdrawal or consumption once construction has been completed.

Many of the new users will be located in or close to the major urban centres, especially Calgary and Red Deer. Others may be located far from these cities due to their proximity to natural resources or their role in transportation.

## 4.6 Indication Of Economic Activity From Applications For Water Licences

Indications of future economic activity can also be derived from details of planned water uses. Table D13 summarizes the licence applications that had been received by AENV as of March 2000. For a variety of reasons, the list of applications includes some which will not be approved and others which will be approved but not activated. Nonetheless, the impression is that large volumes are being considered for possible future withdrawal and consumptive use.

In total, the volumes being considered in March 2000 for future consumptive use (i.e. consumption plus losses) were about two-thirds of the consumptive use specified in licences which were current in 1996. The actual number of licence applications, though, is only about 6% of the number of licences in existence in 1996. The comparison between existing licences and applications is shown in Table 4.2 below.

**Table 4.2 Existing Licences (1996) Versus Licence Applications**

| | MAD ($dam^3$) | CONS ($dam^3$) | Losses ($dam^3$) | Returns ($dam^3$) | Number of Licences |
|---|---|---|---|---|---|
| Licences Existing in 1996 (Tables D4 and D5e) | 1,294,077 | 403,349 | 216,933 | 673,795 | 10,181 |
| Licence Applications in March 2000 (Table D13) | 502,837 | 494,257 | 8,171 | 408 | 597 |

Observations from a review of the list of applications are as follows:

- a substantial amount of water has been applied for in the stockwatering, municipal and industrial categories – particularly in the South Saskatchewan sub-basin;
- licenced water use is likely to grow significantly in the near term; and
- licenced water use will increase in a sporadic fashion and unevenly throughout the study area. Economists would ascribe the latter phenomenon to the essential "lumpiness" of construction investments.

One example of the extreme difficulty in forecasting the location and timing of a major investment is the ongoing attempt by the Taiwan Sugar Corporation to gain approval to build a large intensive hog-raising operation in Alberta (see CD1 in Table D2). After being unsuccessful in its bid to locate in the County of Forty Mile No. 8 (within the study area), the company recently received the necessary permission to build from the municipal government of the County of Flagstaff No. 29 (outside the study area) but the decision is now being appealed.

Water use estimates from previous studies also provide an indication of current and future trends including reducing per capita municipal consumption, lower oil and gas injection rates per capita and significant increases in industrial use. The South Saskatchewan River Basin Planning Program (SSRBPP) by Alberta Environment (1984) reports municipal and industrial use values for the year 1981. Comparable values with the estimated actual uses for 1996 indicates the following:

- total municipal consumptive use has increased by less than 20% over this 1981-96 period compared with a 27% increase in population confirming a lower per capita consumption trend;

- total consumptive use in the major cities (Red Deer, Calgary, Lethbridge and Medicine Hat) has decreased nearly 8% in this period despite a 28% increase in population;

- consumptive use from the towns in the Mountain View system has increased 9.4% compared with a population increase of 20% in these towns;

- oil and gas injection increased 12% over the 1981-96 period; and

- consumptive use increased over 200% for industries other than injection (though an exact comparison is not available because the 1981 data excludes minor uses of less than 410 $dam^3$ and may include municipally supplied industries).

## 4.7 Expectations Of Municipalities With Respect To Future Water Users

The completed questionnaires received from a number of municipal officials indicated expectations for new non-household water users entering these municipalities in the near future. Table 4.3 below sets out these expectations.

**Table 4.3 New Water Users Expected to Locate in the SSRB**

| Jurisdiction | New Water Users Expected to Locate in the Jurisdiction |
|---|---|
| City of Calgary | Electric power generation |
| City of Lethbridge | Food processors |
| City of Red Deer | Petrochemical |
| City Airdrie | Food processors, light industrial and warehouse distribution, high tech |
| City of Medicine Hat | Institutional and commercial users |
| County of Mountainview No.17 | Industrial and commercial |
| County of Forty Mile No. 8 | Intensive livestock |
| County of Stettler No. 6 | Chemical and oilfield manufacturers, intensive livestock operations |
| Lacombe County No. 14 | Intensive livestock operations |
| County of Camrose No. 22 | Food processing |
| M.D. of Foothills No. 31 | Intensive livestock, small industrial and manufacturing |
| M.D. of Acadia No. 34 | Intensive livestock operations |
| M.D. of Bighorn No. 8 | Oil and gas |
| M.D. of Rockyview No. 44 | Co-generation power plant and industrial users |
| M.D. of Willow Creek No.26 | Intensive livestock operations |
| Town of Strathmore | Industrial users |
| Town of Innisfail | Recreation facility |
| Town of Eckville | Hotel |
| Town of Lacombe | Beverage manufacturing, retail and commercial |
| Town of Ponoka | Oil and gas, retail |
| Village of Irricana | Light industrial |
| Town of Didsbury | Minerals |
| Mun. of Crowsnest Pass | Hotel and campground |
| Town of Pincher Creek | Highway maintenance |
| Town of Redcliff | Horticulture and light industry |

The overall impression provided by the questionnaire responses is that, in many cases, municipal officials do not know what types of new non-household water users they can anticipate.

## 4.8 ANTICIPATED TREND IN LIVESTOCK INVENTORIES

Livestock specialists are generally unwilling to forecast livestock numbers even for the near term and there appear to be no long-term livestock forecasts published on a provincial or regional basis.

The Toma and Bouma study "A Sustainable Growth Strategy for the Alberta Agri-Food Sector" (1997) utilized scenario planning to determine the growth rates required in different agricultural activities in order for the Alberta agri-food sector to become a $20 billion manufacturing industry and a $10 billion production sector by 2005. They conclude that the goal of a $10 billion primary production sector, adopted by the Provincial Government in 1995, will be most likely achieved through an aggressive expansion of key livestock sectors, namely beef feedlots and hogs. They further believe that the long-term prospects for additional trade exports are strong, especially to the US and to Asia.

Only one of the four scenarios developed in the Toma and Bouma study foresees production revenues reaching $10 billion by the year 2005. This scenario features a doubling of the beef feedlot population, a tripling of the hog population and other livestock sectors following historical growth rates. It is estimated that this scenario will require an additional 9.9 billion gallons (45,000 $dam^3$) of water per year. Another scenario, which provides only $9.1 billion in production revenues by 2005, requires increasing the beef cow herd by 20% over current levels, while tripling the hog population and increasing beef feedlot populations by 50%. It is estimated that this scenario will require an additional 6.3 billion gallons (28,600 $dam^3$) of water per year.

The Toma and Bouma study does not venture to suggest which scenario is more probable or how growth in livestock activity might be distributed within the province. However, there are suggestions that new beef feedlots and intensive hog operations are increasingly locating in areas with low human populations and where municipal governments are willing to accommodate these new investments. The Peace District, in particular, is mentioned as an area of substantially increased cattle numbers and feedlot operations.

Future trends have also been analyzed in a 1998 study conducted by Alberta Agriculture, Food and Rural Development called "The Changing Structure of Farm Businesses as the Industry Expands to the Year 2005." In addition to further growth in average farm size, there is an expectation that livestock populations will grow province-wide, mainly through the addition of more intensive livestock operations.

In many parts of the more densely populated Bow River Basin and in some parts of "feedlot alley" (located east and west of Lethbridge), there may be few opportunities for

expansion of livestock numbers. With a growing number of rural acreages and other country rural residential developments, there is a high probability of conflicts arising between intensive livestock operators and non-farm rural residents over issues such as odour, dust and water quality. The recent publicity surrounding the efforts of the Taiwan Sugar Company to gain permission to construct a large pig operation in the County of Forty Mile No. 8 is a case in point. The quality of groundwater has become an especially sensitive issue since the Walkerton, Ontario tragedy.

Alberta Agriculture, Food and Rural Development (pers.comm., Murray Davison, November 21, 2000) indicates that it is standing by its 1995 voluntary Code of Practice and its decision to leave the permitting of new intensive livestock operations and feedlots in the hands of municipal governments. However, the provincial government is playing a greater role in the specification of technical requirements applicable to permit applicants. Two regulations of critical importance are the setting of minimum separation distances between intensive livestock operations and existing residences, and the acreage, technique and timing requirements for spreading or incorporating manure into the soil.

## 4.9 Factors Affecting Population Growth And Economic Activity

Tables D14a to D14c set out 22 factors that will affect the study area's population over the medium and long term. An attempt has been made to indicate how each might be related to population trends in the study area as a whole, in the major cities and in smaller and less populated municipalities.

Table D14a describes a series of macro or societal factors, each of which do or may significantly affect the study area, as well as other parts of Alberta and Canada. Certain of these factors, particularly the two most important ones – growth in electronic communications and changing lifestyle preferences – are fairly well understood and are monitored closely. A couple of other factors are very much dependent on public policy and one, energy pricing and supply, is largely market driven. Probably the least predictable factor is the effect of a possible change in Canada's political boundaries.

Table D14b focuses on a series of micro factors that would seem to operate primarily at the city level. Transportation infrastructure is a critical theme, and key factors that may boost or hinder population growth are suggested. The rise of significant industrial nodes would tend to encourage growth in cities and larger towns. Crime, in contrast, could be a factor that would hinder growth in major cities.

Table D14c provides a series of factors that are believed to affect population growth primarily in rural areas. Several of these reflect the quality of leadership and cohesion which communities can bring to bear in addressing their future (a theme addressed in Telford and Wright, 1999). Three of the identified factors refer to significant trends in agriculture, such as the trend toward fewer and larger farming operations, which will likely lead to further changes in rural population.

## 4.10 CHARACTERISTICS OF FORECASTED ECONOMIC ACTIVITY

In recent years, the economy of Alberta has grown and diversified away from its longtime reliance on oil and gas. Data provided by Alberta Economic Development for the composition of Gross Domestic Product (GDP) in 1985 and 1996 show:

- the portion of GDP contributed by the energy sector declined from 35.9% to 19.8%;
- substantial increases were registered in business and communications services (from 15.3% to 21.1%), manufacturing (6.7% to 10.6%) and finance (10.1% to 13.2%), and
- smaller increases occurred in transportation and utilities (from 9.6% to 11.8%) and retail and wholesale trade (8.0% to 9.9%).

The most significant trend is the growth of Calgary and its adjacent areas. Since the 1940s, Calgary's economy has been known for its "boom" and "bust" cycles attendant more often than not on the price of oil and government regulation of the Canadian oil industry. More recently, natural gas prices have taken on added significance. Price fluctuations in these commodities will likely continue. However, diversification of the provincial and Calgary economies means that the economic fallout from price drops is much less than before. In fact, Calgary has continued to grow over the past three years in spite of world oil prices languishing for a period at US$12-13/barrel.

The agriculture and oil and gas sectors, the traditional mainstays, are still solid contributors to the regional economy. However, there are several others that now play a substantial role. Agri-food processing and petrochemicals have a direct relationship to agriculture and oil and gas. Other light industry and services are very important, including financial and business services, telecommunications and manufacturing. There is also significant activity in the commercial (retail and wholesale) sector, and in recreation and tourism and public administration. Infrastructure growth, including highway expansion, and construction of additional trunk pipelines and power plants is also noteworthy.

Further strengthening of certain industrial sectors will be assisted by policies espoused by the Government of Alberta. This will be especially important for the information and communications technology sector, value-added processing especially in agriculture, and tourism.

# 5.0 FORECASTED WATER USE

## 5.1 THE RELATIONSHIP BETWEEN POPULATION, ECONOMIC ACTIVITY AND WATER USE

Section 3 concluded with a picture of estimated actual water withdrawals and consumptive use in the study area for 1996. This sub-section presents the assumptions made about the growth in water withdrawals and consumptive use of water between the base year (1996) and 2021 and 2046.

### 5.1.1 Stockwatering Use

According to the scenario described in the Toma and Bouma study, it can be anticipated that cow-calf operations will grow by 20% over the 1997-2005 period. They see a much higher growth rate in water usage for intensive livestock operations (including beef feedlots), 61.5%, based on a rise from 16.1 billion gallons (73,000 $dam^3$) in 1997 to 26 billion gallons (118,000 $dam^3$) by 2005. However, they report a widely held view that many of the province's new intensive livestock operations will locate in central and northern areas of the province.

Table 5.1 below indicates how water use for stockwatering is assumed to grow in different parts of the SSRB. The steepest growth rate is anticipated in the sparsely populated RD6 and RD5 sub-basins where new intensive livestock operations can be expected to locate. In all parts of the study area, losses will continue to occur through evaporation and seepage from the many small reservoirs and dugouts that have been constructed specifically for stockwatering.

**Table 5.1 Assumptions for Growth in Stockwatering Use**

| Area | Sub- Basins | Expected growth in withdrawals and consumptive use | |
|---|---|---|---|
| | | 1996-2021 Low/Medium/High | 1996-2046 Low/Medium/High |
| City of Calgary area | B3, B4, Highwood | 0%/5%/10% | 0%/5%/10% |
| City of Red Deer area | RD2, RD3, RD4 | 5%/10%/15% | 10%/15%/20% |
| Plains areas with population centres and/or irrigated agriculture | RD1, LBR, O2, O3, O4, SS1, B6, B7, SS2, B5, Belly, St. Mary, O1, Willow, Waterton, | 25%/30%/35% | 35%/40%/45% |
| Other sparsely populated plains areas | RD6, RD5 | 40%/50%/60% | 60%/75%/90% |
| Mountains/foothills | B1, B2, Elbow | 0%/5%/10% | 0%/5%/10% |

### 5.1.2 Other Agricultural Use

The growth in water withdrawals and consumptive use for the "other agricultural" category is assumed to match forecasted population. Low and high forecasts are taken as variants of the medium case, as indicated in Table 5.2.

**Table 5.2 Assumptions for Growth in Other Agricultural Water Use**

| Year | Expected growth in Other Agricultural withdrawals and consumptive use | | |
|---|---|---|---|
| | Low | Medium | High |
| 2021 | 95% of Population Growth 1996/2021 | Population Growth 1996/2021 | 105% of Population Growth 1996/2021 |
| 2046 | 90% of Population Growth 1996/2046 | Population Growth 1996/2046 | 110% of Population Growth 1996/2046 |

The reasoning here is that typical users in this category – golf courses, tree farms and parks – rely heavily on local population and tourists. It is assumed that growth in tourism is offset by conservation measures including advances in application techniques and selection of more drought resistant species.

### 5.1.3 Municipal Use

Growth in municipal water use is expected to closely follow forecasted population, although some decline in per capita usage can be expected as water conservation programs and cost-based water pricing become more widespread. The authors are aware of two municipalities, the Towns of Okotoks and Brooks, that have embraced a long-term target of reducing per capita water consumption by 30%. Table 5.3 below sets out the assumptions used for the "municipal" use category in this study.

**Table 5.3 Assumptions for Growth in Municipal Water Use**

| Area | Sub- Basins | Expected % annual growth in per capita withdrawals and consumptive use* Low/Medium/High |
|---|---|---|
| City of Calgary | B3, B4 | Decline 15%/10%/0% by 2021 then another 10%/5%/0% by 2046 |
| City of Red Deer Plus Ponoka and Lacombe (in medium and high cases) | RD2, RD3, RD4 | Decline 15%/10%/0% by 2021 then another 10%/5%/0% by 2046 |
| City of Lethbridge | O3 | Decline 15%/10%/0% by 2021 then another 10%/5%/0% by 2046 |
| City of Medicine Hat | SS1 | Decline 15%/10%/0% by 2021 then another 10%/5%/0% by 2046 |
| Rest of Red Deer basin | RD 1, RD 5, RD 6 | Decline by 10%/5%/0% by 2021, then another 5%/2.5%/0% by 2046 |
| Rest of Bow basin | B1, B2, B5, B6, B7, Elbow, Highwood | Decline by 10%/5%/0% by 2021, then another 5%/2.5%/0% by 2046 |
| Rest of Oldman basin and South Saskatchewan | O1, O2, O4, St. Mary, Waterton, Willow, SS 2, Belly, LBR | Decline by 10%/5%/0% by 2021, then another 5%/2.5%/0% by 2046 |

* For the small portion of municipal usage which corresponds to recreational facilities the effect of conservation was assumed to be less significant. Regardless of the sub-basin, the low/medium/high cases for recreational facilities assumed a 10%/5%/0% decline by 2021 with no further decline beyond that date.

### 5.1.4 Industrial Use

The estimated actual 1996-99 increase in industrial consumptive use observed from AENV licence records was 6.4%. The average masks some significant variation. However, it is possible to conclude that a steadily larger proportion of new industries are light manufacturing and high technology related, with lower water requirements than traditional industrial users. There are indications that water usage of many traditional users, such as oil and gas injection, is not expected to grow due to technological advances and improved conservation and recycling practices.

It is assumed the bulk of the growth in industrial water use will take place in and around the City of Calgary and, to a lesser extent, the City of Red Deer. Some growth will also take place in the sub-basins aligned with Highway 2 (Red Deer to Fort McLeod), Highway 3 (Fort McLeod to Medicine Hat) and Highway 1 (Calgary to Medicine Hat). Minimal growth will be experienced in other sub-basins and will mainly be confined to oil and gas, transportation and electric power initiatives.

Table 5.4 below provides the assumptions used for the "industrial" use category.

**Table 5.4 Assumptions for Growth in Industrial Water Use**

| Area | Sub-Basins | Expected growth in withdrawals and consumptive use | |
|---|---|---|---|
| | | 1996-2021 Low/Medium/High | 1996-2046 Low/Medium/High |
| City of Calgary | B3, B4 | 150%/200%/250% | 300%/400%/500% |
| City of Red Deer | RD2, RD3, RD4 | 125%/150%/175% | 250%/300%/350% |
| Along Highways 1, 2 and 3 excepting Calgary and Red Deer | RD5, RD1, Highwood, LBR, Willow, O2, Waterton, O3, O4, SS1, B6, RD6, B7, SS2 | 75%/100%/125% | 150%/200%/250% |
| Other plains areas | B2, B5, Belly, St. Mary, | 40%/50%/60% | 75%/100%/125% |
| Mountains/foothills | B1, Elbow, O1 | 0%/2.5%/5% | 0%/5%/10% |

### 5.1.5 Water Management Use

Since water management use closely reflects decisions made by water management authorities including AENV, the authors were unsure how to forecast it. In view of the fact that more water management uses will be needed as pressures on existing water resources increase, it was decided to pro-rate water management withdrawals on the basis of population growth throughout the study area, as indicated below.

**Table 5.5 Assumptions for Growth in Water Management Water Use**

| Year | Expected growth in withdrawals and consumptive use | | |
|---|---|---|---|
| | Low | Medium | High |
| 2021 | 95% of Population Growth 1996/2021 | Population Growth 1996/2021 | 105% of Population Growth 1996/2021 |
| 2046 | 90% of Population Growth 1996/2046 | Population Growth 1996/2046 | 110% of Population Growth 1996/2046 |

## 5.2 Forecasted Water Withdrawals And Consumptive Use - 2021

Table D15 presents the forecasts of actual water withdrawals for 2021. The medium case is 1,246,535 $dam^3$, which is approximately 46% higher than the 1996 level. The forecasted low and high cases are 11.3% below and 13.7% above the medium case, respectively.

Table D16 shows forecasted actual consumption for the study area for 2021. Utilizing the same growth assumptions as for withdrawals, the resulting forecast of consumptive use for 2021 is 705,767 $dam^3$ for the medium case, approximately 50% higher than the 1996 level. The forecasted low and high cases are 10.4% below and 11.1% above the medium case, respectively.

Table D15 indicates that the basin that will have the largest withdrawals in 2021 is the Bow Basin, with 43% of the total. This includes a very substantial municipal withdrawal for the Calgary area. The second and third ranking basins, respectively, are the Red Deer and Oldman. The South Saskatchewan sub-basin continues to have the lowest withdrawal of the four main sub-basins.

Table D16 shows a different pattern for consumptive use. The basin with the largest consumptive use in 2021 will be the Red Deer Basin, with 35% of the total. Industrial and stockwatering uses will account for 64.3% of the consumptive use in the Red Deer basin. The Red Deer is followed by the Oldman, then the Bow and the South Saskatchewan sub-basins in order of magnitude.

## 5.3 Forecasted Water Withdrawals And Consumptive Use - 2046

Table D17 presents the forecasts of actual water withdrawals for 2046. The forecast for the medium case is 1,623,372 $dam^3$, which is 90% higher than the 1996 level. The forecasted low and high cases are 20.1% below and 24.2% above the medium case, respectively.

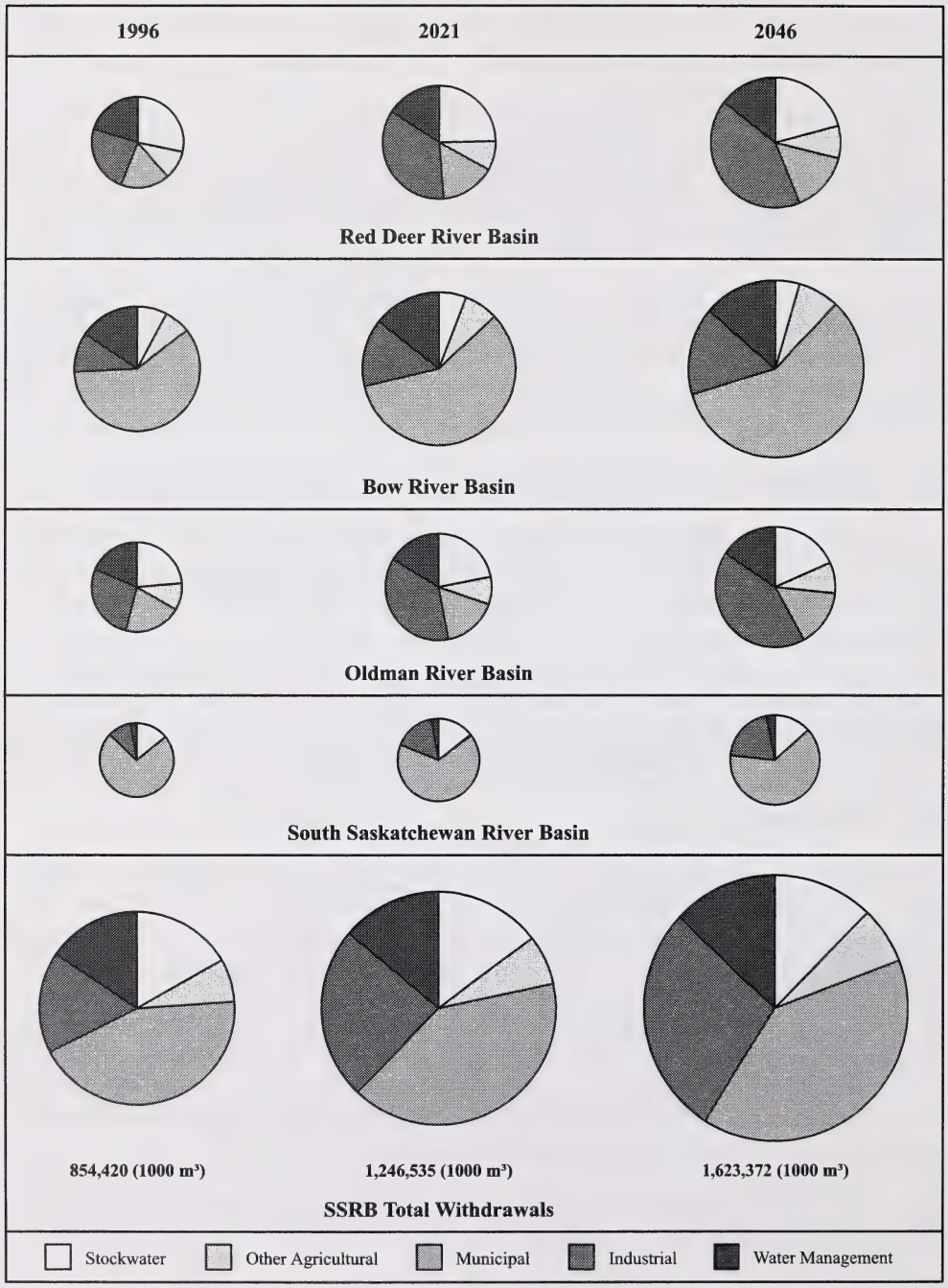
Table D18 shows forecasted actual consumption for the study area for 2046. Utilizing the same growth assumptions as for withdrawals, the resulting forecast of consumptive use for 2046 is 918,733 $dam^3$ for the medium case, nearly 96% higher than the 1996 level. The forecasted low and high cases are 16.8% below and 18.5% above the medium case, respectively.

Table D17 indicates that the basin with the largest withdrawals in 2046 is the Bow Basin, with 44% of the total. Municipal withdrawals in the Calgary area will continue to dominate. The second and third ranking basins, respectively, are the Red Deer and Oldman. The basin with the smallest withdrawals is the South Saskatchewan sub-basin.

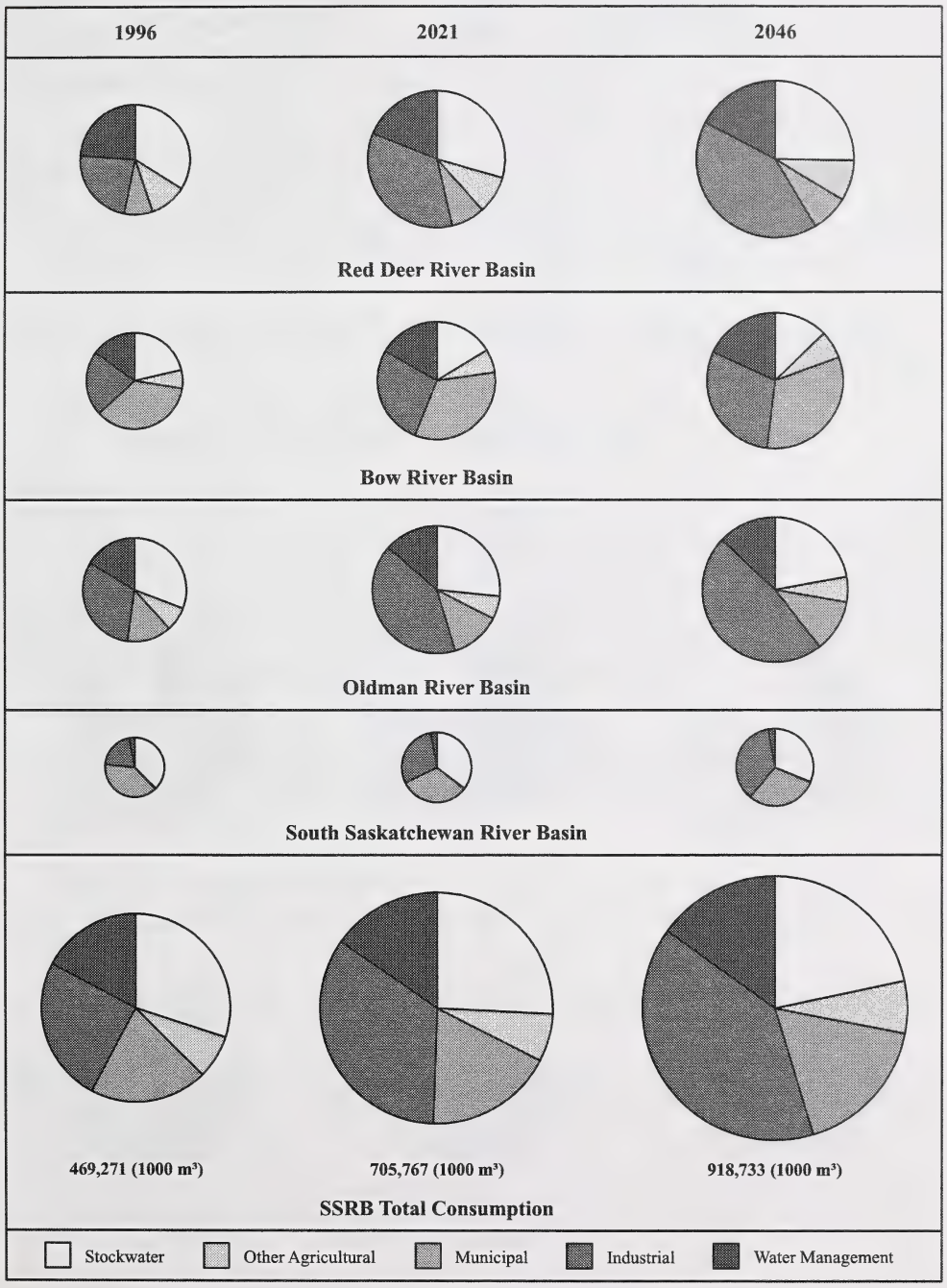
A contrasting pattern for consumptive use is seen in Table D18. The basin with the largest consumptive use in 2046 will be the Red Deer basin, with 35.3% of the SSRB total. Industrial and stockwatering uses will account for nearly 65% of the Red Deer uses. The magnitude of consumptive uses in the Red Deer is followed by the Oldman, then the Bow and the South Saskatchewan sub-basins.

Figures 5-1 and 5-2 summarize current and forecasted withdrawals and consumptive use respectively for the medium growth case.

**Figure 5-1 Projected Withdrawals by Basin - Medium Growth Case**



## Figure 5-2 Projected Consumptive Use by Basin - Medium Growth Case



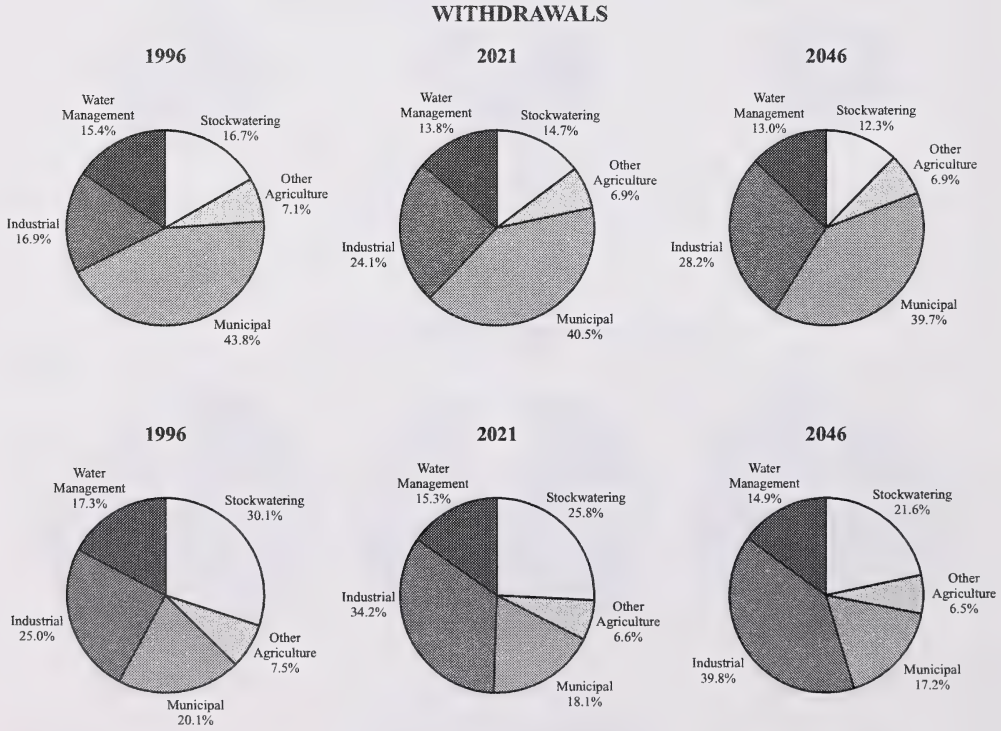
## 5.4 DISTRIBUTION OF WATER DEMANDS BY USE CATEGORY

Tables D15 to D18 show the relative importance of different use categories and how they are expected to change over the forecast period. In terms of withdrawals, the municipal use category continues to be predominant, although its share declines slightly (from 44% in 1996 and just under 40% in 2046). The industrial use category, in second place, is expected to increase its share (from 17% in 1996 to 28.2% in 2046).

With respect to consumptive use, the industrial use category ranks first and its share increases markedly over the forecast period (from 25% in 1996 to 39.8% in 2046). Stockwatering ranks second and its share is expected to decrease over time (from 30.1% in 1996 to 21.6% in 2046).

The distribution of withdrawals and consumptive use for the SSRB are summarized by use category in Figure 5-3.

**Figure 5-3 SSRB Distribution of Water Use by Use Category**



## 5.5 PER CAPITA CONSUMPTION RATES

As indicated in Section 5.1, it is expected (in the low and medium cases) that municipal consumption per capita may decrease moderately to 2021 with a further slight decline to 2046. The high case is assumed to reflect no further decline in per capita consumption during the forecast period.

The rationale for expecting such changes is based on the responses received from jurisdictions within the study area. In the responses:

- 28 jurisdictions (65% of all responders) indicated they had implemented some water conservation measures and 15 (35%) had implemented none at all;
- there was striking variation in the types of conservation measures reported; and
- only five jurisdictions (12% of all responders) reported having any targets for water conservation, and only two of these involved quantified goals.

Questionnaire responses pointed to an increasing awareness among municipal governments of policy tools that are available for promoting water conservation, especially with regard to domestic uses. The 1999 report *Non-Irrigation Consumptive Demand Forecasts – Little Bow EIA* (Hydroconsult, 1999) and certain questionnaire responses in the current study, indicated municipal administrators showed a knowledge of, and in some instances, extensive experience with a broad range of policy levers. The following list encompasses the alternatives that were mentioned:

- increased water (and sewer) charges, increases in water charges at certain times of the year (such as at times of greatest demand), and levying of charges on non-traditional users (such as construction companies which use water for dust control, settling dirt and curing concrete);
- metering (and checking/upgrading of meters) – metering for domestic and other user categories in order to gauge accurately actual water used and invoice users for that amount;
- where metering is not required it may be promoted through a metering incentive program;
- conservation-oriented increasing rate schedules in which the price increases as water use increases;
- leak detection awareness programs to assist water users to control costs and to minimize losses in the distribution system through water line repair or replacement;

- restrictions on specified water uses at times of greatest demand (such as bans or partial controls on watering of residential lawns and gardens or restricted covenants on lawn watering in acreages);

- water management plans for new subdivisions (which may place restrictions on household fixtures such as required inclusion of low water-use toilets and shower-heads) and intensive livestock operations;

- appeals and educational campaigns (through newspaper ads, flyers and notices included with utility bills) encouraging water conservation through judicious lawn and garden watering (including use of irrigation canal water where available), employment of low water-use devices, and other practices;

- targeted educational campaigns in schools and other segments of the community that are linked to broad issues of environmental protection and sustainable development; and

- use in municipally-owned landscaping of drought-resistant plant species (xeriscaping).

Table D19 and Figures 5-4 and 5-5 below reveal how the data in Tables D15 to D18 look on a per capita basis. Decreases are evident in per capita total withdrawals and consumptive use over the forecast period, largely as a result of demand management initiatives. Withdrawals are expected to decline from 659 $m^3$/person/year in 1996 to 585 $m^3$/person/year in 2046. Consumptive use is expected to decline from 362 $m^3$/person/year in 1996 to 331 $m^3$/person/year in 2046.

**Figure 5-4 Medium Case Per Capita Withdrawals by Basin**

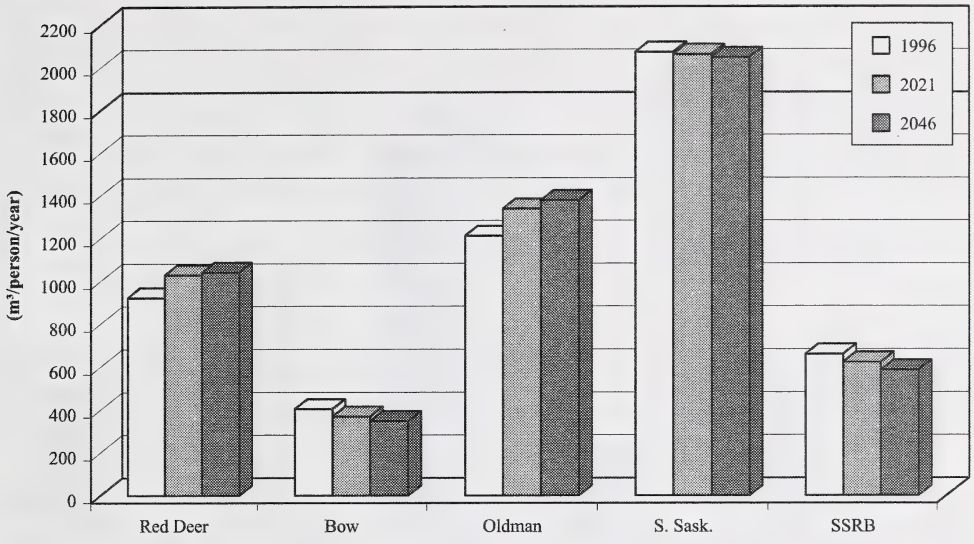
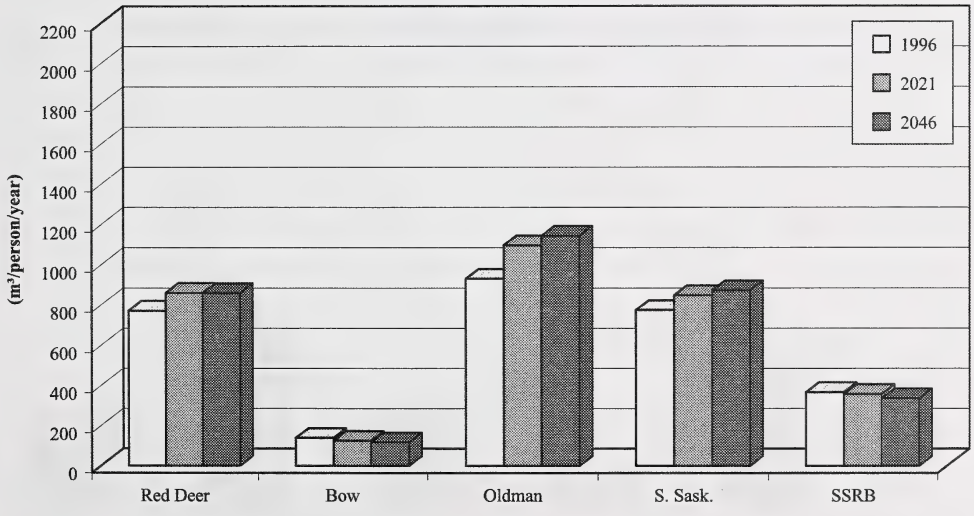



**Figure 5-5 Medium Case Per Capita Consumptive Use by Basin**




With the exception of industrial use, decreases in per capita withdrawals and consumptive use are evident in all user categories, as indicated in the charts below. The decline is expected to be substantial in stockwatering, due to environmental regulations and citizen concerns. Industrial use, on the other hand, is forecast to expand appreciably on a per capita basis, reflecting the greater industrialization of the study area.

**Figure 5-6 Medium Case SSRB Per Capita Withdrawals by Use Category**

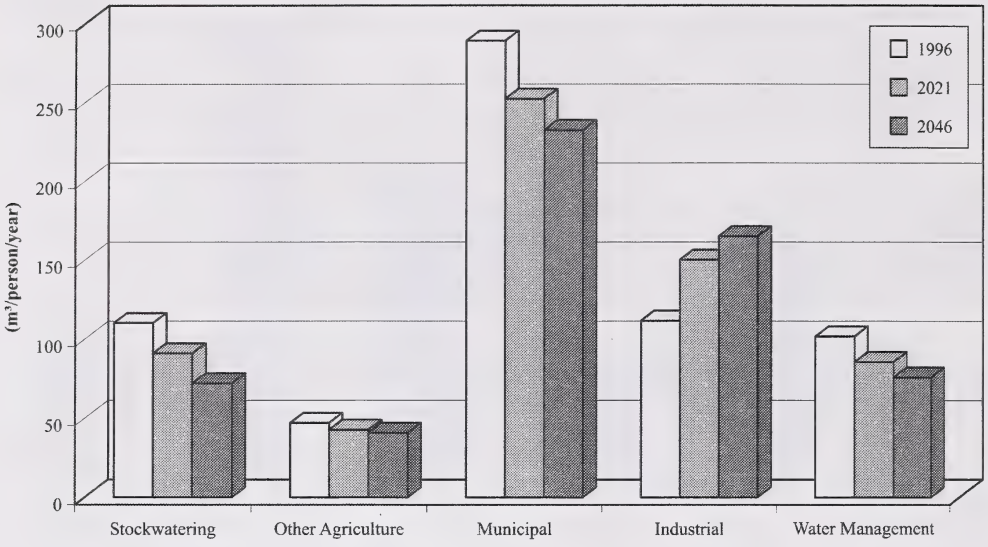
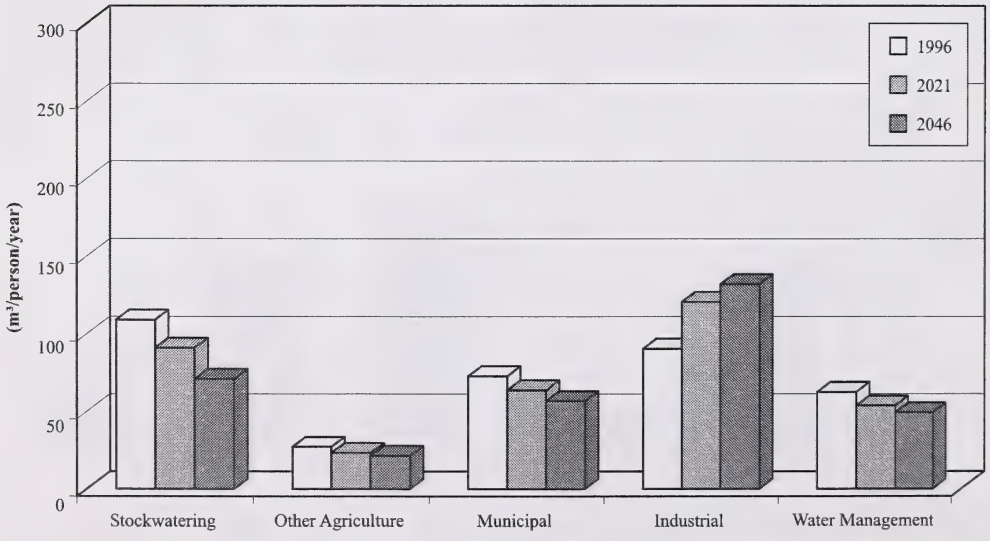



**Figure 5-7 Medium Case SSRB Per Capita Consumptive Use by Use Category**




Another finding from Table D19 is that municipal withdrawal per capita is least in the northernmost basin (Red Deer) and greatest in the dry south and southeast of the study area (Oldman and South Saskatchewan Sub-Basin).

An attempt to check on the reasonableness of forecasted per capita consumption numbers for the study area involved consideration of increases in estimated actual consumptive

use for the 1996-99 period for each use category (Table D10). With the conversion of these increases into annual growth rates and subsequent comparison to an average annual population growth rate (taken from Table D12), it was possible to suggest what 2021 consumptive use would be if it followed the same growth pattern observed in the 1996-99 period. The result was that 2021 consumptive use calculated in this fashion would be moderately higher than that shown in Table D16. Factors believed to be underlying this difference are the increased share of industrial demand relative to other categories, and the greater adoption of conservation measures by major user groups.

## 5.6 Summary Of Forecasted Water Withdrawals, Consumptive Use And Return Flow

A summary of the estimated actual and forecasted water withdrawals and consumptive use (consumption plus losses) is presented in Table D20. Return flow (withdrawals less consumptive use) is also shown. Amounts are shown for the medium case for each basin, along with high and low sensitivities.

Withdrawals and consumptive use are expected to increase by 46% and 50%, respectively, between 1996 and 2021. Over the following 25 years, withdrawals and consumptive use are both expected to rise another 30%.

In 2021, forecasted withdrawal and consumptive use differences between cases range from –10% to +14%. The differences for 2046 range from –17% to +24%. There is a greater spread between low and high cases in the Bow Basin than in the other river basins. Readers may wish to compute additional sensitivities from the data provided in this report.

# 6.0 RECOMMENDATIONS FOR FURTHER STUDY

A number of limitations of this study have been noted at various points in the text. Most important among them is the quality of the primary data. The following actions would help facilitate future studies of water withdrawals and consumptive uses:

1. The categorization of licences according to user type is not detailed enough nor is it standardized among AENV offices. It would be highly beneficial to have the master list of licences revised to more accurately show user category. One category that should be separated is the household/residential use that is currently included within the "municipal" category, since residential use accounts for around 40% of the water supplied by municipalities (Tate and Lacelle, 1987). There is also the likelihood of some double-counting of licences and licence applications, a situation which could be remedied by cross-checking all outstanding licence applications. The accounting of inter-basin transfers would be easier if the EMS database had an additional column or columns to identify where return flows are directed.

2. The change in AENV policy with respect to submission of water use returns by licence holders has reduced the ability to track actual consumption. The consultants recommend that the provincial government re-institute mandatory water use reporting for major water users. Since available supplies are under increasing pressure, trends in actual consumption should be followed more closely than is done at present. Particular attention should be given to better quantifying actual uses in the industrial and water management categories. An automated internet database compilation system could be implemented that would reduce reporting and data maintenance costs.

3. At least one important modelling exercise has been reported in the literature which is relevant as background to the current study – the Environment Canada Water Use Analysis Model (WUAM) (Kassem, Tate and Dossett, 1994). This model, and possibly others, should be examined in advance of other water withdrawal and consumption studies being conducted in Alberta.

4. Only about half of the jurisdictions in the study area responded to the questionnaire sent out by the consultants. Follow-up by phone did not substantially improve the response. While this level of response is not unusual for mail-out questionnaires, it is less satisfactory than the face-to-face interview approach. The latter was fully employed in the 1999 report *Non-Irrigation Consumptive Demand Forecasts – Little Bow EIA* (Hydroconsult, 1999), during which detailed information was obtained for all 11 jurisdictions (ten municipalities and one First Nation) located in the study area. The consultants recommend that the scope of future studies be formulated in a manner that more fully utilizes face-to-face contact with information providers within local governments and First Nations.

5. The methodology employed in the current study utilizes various growth assumptions that are not firmly rooted in empirical research. One set of assumptions that could be examined more closely relates to the effects of demand management measures in

Alberta. The potential benefits of demand management have been shown in many and diverse situations to be more cost effective than supply management solutions (Tate and Lacelle, 1995). Research into the demand response to policy changes would be instructive both in the context of future demand assessment exercises, as well as being of interest to local governments and First Nations. The consultants recommend that a study be commissioned into the effects of alternative demand management measures on water demand in Alberta.

The joint Review Panel for the Little Bow Project Environmental Impact Assessment has required an evaluation of the full range of non-storage options in the Highwood and Upper Little Bow River basins. This is a positive initiative. When completed, consideration should be given to its applicability to the rest of Alberta.

6. Losses and the extent to which these are being reduced over time is another complex issue. Being outside the consultants' ToR, this has not been addressed in the present study. Research into the identification and management of losses would aid future forecasts of consumptive use.

# APPENDIX A

## Terms of Reference

**Schedule A**

**Year 2000 Review of Water Management**
**in the South Saskatchewan River Basin**

**Non-District Water Use Projections**
**(excluding irrigation within irrigation districts)**

**Terms of Reference**

1. **Purpose:** To develop projections for

   - population
   - water use and effluent discharge for all withdrawal purposes except irrigation within irrigation districts

   for the South Saskatchewan River basin in Alberta

2. **Scope:**

   a. **Time Frame:** The base year for the projections will be 1996. Data for other years will be needed for trend analysis and when 1996 data are not available or inappropriate to use.

   b. **Study Area:** South Saskatchewan River basin in Alberta, which includes the Oldman, Bow, Red Deer River, and South Saskatchewan sub-basins.

   c. **Water Bodies to Focus On:** South Saskatchewan River, Oldman River, Bow River, Red Deer River, and their major tributaries.

   d. **Jurisdictions to Cover:**

| | |
|---|---|
| **Cities** | Airdrie, Calgary, Lethbridge, Medicine Hat, Red Deer |
| **Counties** | Camrose, Cardston, Clearwater (county as of July 1st), Cypress, Forty Mile, Kneehill, Lacombe, Lethbridge, Mountain View, Newell, Paintearth, Ponoka, Red Deer, Starland, Stettler, Vulcan, Warner, Wetaskiwin, Wheatland |
| **First Nations** | Blood, Peigan, Siksika, Stoney, Tsuu T'ina |
| **Improvement Districts** | Kananaskis (also see national parks) |
| **Irrigation Districts** | Aetna, Bow River, Eastern, Leavitt, Lethbridge Northern, Magrath, Mountain View, Raymond, Ross Creek, St. Mary, Taber, United, Western |
| **Municipal Districts** | Acadia, Bighorn, Pincher Creek, Ranchlands, Rocky View, Taber, Willow Creek |

| | |
|---|---|
| **Municipality** | Crowsnest |
| **National Parks** | Banff, Waterton. |
| **Special Areas** | Special Areas Board |
| **Towns** | Banff, Bassano, Bowden, Bow Island, Brooks, Canmore, Cardston, Carstairs, Chestermere, Claresholm, Coaldale, Coalhurst, Cochrane, Crossfield, Didsbury, Drumheller, Eckville, Fort Macleod, Granum, Hanna, Innisfail, Lacombe, Magrath, Nanton, Olds, Oyen, Penhold, Picture Butte, Pincher Creek, Raymond, Redcliff, Stavely, Strathmore, Sundre, Sylvan Lake, Taber, Three Hills, Trochu, Vauxhall, Vulcan |

Contact with municipalities in the Highwood River Basin will be needed to, as required, update and augment the water use projections for the Little Bow Project.

**e. Assumptions:**

- Do not make a distinction between surface and ground water, i.e., assume that, in the future, all water will be withdrawn from surface water sources.
- Assume that allocations would be made if a) instream objectives are met and b) existing licences are utilized, new licences are issued, adequate storage is provided, or water rights transfers are arranged.

**f. Types of Activity:** Non-district water uses include household and municipal (including water co-operatives), industrial, private and First Nations irrigation (i.e., irrigation not served by irrigation districts), and agricultural uses (other than irrigation and including traditional agriculture uses) that are allowed under the Water Act.

**g. Type of Estimates:** Population, water use, and effluent discharge information will be calculated for individual municipalities and by these major sub-basins or reaches:

- Red Deer River upstream of Dickson Dam
- Red Deer from Dickson Dam to Red Deer
- Red Deer River from Red Deer to Joffre Industrial complex
- Red Deer River from Joffre Industrial complex to "SAWSP" diversion.
- Red Deer River from "SAWSP" diversion to Deadfish diversion
- Red Deer River from Deadfish diversion to the mouth

- Bow River upstream of Ghost Dam
- Bow River from Ghost Dam to Bearspaw Dam
- Bow River from Bearspaw Dam to Western Headworks diversion (including the Elbow River downstream of Glenmore Dam)
- Bow River from Western Headworks diversion to Highwood River
- Bow River from Highwood River to Carseland diversion
- Bow River from Carseland diversion to Bassano Dam
- Bow River from Bassano Dam to the mouth

- Elbow River upstream of Glenmore Reservoir
- Highwood River sub-basin (previously covered for the Little Bow Project)

- Oldman River upstream of Oldman Dam
- Oldman River from Oldman Dam to Lethbridge
- Oldman River from Lethbridge to Little Bow River
- Oldman River from Little Bow River to the mouth
- Waterton River sub-basin
- Belly River sub-basin
- St. Mary River sub-basin
- Willow Creek sub-basin
- Little Bow River sub-basin (partially covered for the Little Bow Project)
- South Saskatchewan River from Bow-Oldman confluence to Medicine Hat
- South Saskatchewan River from Medicine Hat to Red Deer confluence

Water quantity data will include both withdrawal and consumptive use (total and per capita).

Effluent discharge data will include volume of discharge, discharge rate, duration of discharge, timing of discharge (e.g., continuous, spring or fall, or batch discharges), and type of treatment. **The detailed requirements for effluent discharge data collection and projections will be specified later.**

The location of withdrawals or discharges will be identified, including which water bodies are expected to be affected. The timing or distribution of withdrawal and effluent discharge during the year will be estimated by purpose and geographic location. Information will be provided on the proportion of rural domestic use and effluent discharge that is supplied through individual vs. communal systems.

Social and economic factors related to water use and effluent discharge will include relevant issues such as trends in water consumption/conservation, trends in economic activity and technology, significant nodes of economic activity, trends in environmental protection, changing lifestyle and consumer awareness, and global markets.

As required, the water use projections prepared for the Little Bow Project will need to be updated, augmented, and made consistent with the projections for the South Saskatchewan River basin.

**h. Analytical Methods:** Rigorous and reliable techniques for data collection and analysis will be used.

**3. Tasks**

**a. Inventory:** Collect and analyze existing data on

- water licences
- water use
- effluent discharge approvals
- effluent discharge
- population
- social and economic factors related to water use and effluent discharge.

**b.** **Projections:** Estimate population, agricultural, commercial, and industrial activity, and non-district water use in the Study Area for

- 1996
- 2021
- 2046.

**c.** **Documentation:** All data and analysis will be fully documented A report will be produced and the originals of the report plus fifteen copies of the report will be provided to Alberta Environment.

# APPENDIX B

## Persons Consulted

## APPENDIX B PERSONS CONSULTED

Bob Morrison, Water Planner, Bow Water Management, Natural Resources Service, AENV, Calgary

Wendell Koning, Limnologist, Water Quality Water Sciences Branch, AENV, Calgary

Doug Thrussel, Water Analyst and Basin Planner, Parkland Region, AENV, Red Deer (by telephone)

Dave Cable, Water Data Management Section, Water Sciences Branch, AENV, Edmonton (by telephone)

David Neilson, Section Head, Farm Water Management Section, Conservation and Development Branch, Alberta Agriculture, Food and Rural Development, Edmonton (by telephone)

Randy Poon, Engineer, Water Administration Branch, Natural Resources Service, AENV, Calgary

Peter Pui, Surface Water Administrative Engineer, Water Administration Branch, Natural Resources Service, AENV, Red Deer

Kathleen Murphy, Engineer, Water Administration Branch, Natural Resources Service, AENV, Lethbridge

Doug Ohrn, Planning Officer, Regional Technical Support, Natural Resources Service, AENV, Red Deer

Steve Johnson, Regional Municipal Engineer, Environmental Service – Parkland Region, AENV, Red Deer

Brock Rush, Municipal Engineer, Municipal Approvals – Bow Region, AENV, Calgary

Janet Yan, Systems Analyst, Information Technology Section, AENV, Edmonton

Ed Bulger, Systems Analyst, Information Technology Section, AENV, Edmonton

Reynold Jaipaul, Livestock Statistician, Alberta Agriculture, Food and Rural Development, Edmonton (by telephone)

Walter Valentini, Regional Manager, Calgary Region, Alberta Economic Development, Calgary

Don Schopflocher, Biostatistician, Health Surveillance, Alberta Health, Edmonton (by telephone)

Bill Shaw, ACP, MCIP, report review consultant for City of Red Deer

Bill Hyshka, Head, Economics and Public Finance, Statistics, Alberta Treasury (by telephone)

Chris Jacyk, Associate Economist, Corporate Economics & Regulatory Affairs, City of Calgary

Lucette Dell'Oso, Statistics Canada, Ottawa (by telephone)

Bahia Laham, Statistics Canada, Calgary

Prof. Ted Chambers, Director, Western Centre for Economic Research, University of Alberta, Edmonton (by telephone)

Prof. Wayne McVey, Population Research Laboratory, University of Alberta, Edmonton (by telephone)

Prof. Robert Mansell, Head, Economics Department, Department, University of Calgary (by telephone)

Jurisdictions Responding to Questionnaires and Interviews

City of Airdrie
City of Calgary
City of Lethbridge
City of Medicine Hat
City of Red Deer
County of Camrose #22
County of Forty Mile No.8
County of Paintearth
County of Stettler
Kananaskis Imp District
Lacombe County
MD of Acadia No. 34
MD of Foothills No. 31
MD of Rocky View #44
MD of Willow Creek No.26
Mountain View County
Muni.of Crowsnest Pass
Village of Burnstick Lake
Town of Bashaw
Town of Black Diamond
Town of Bow Island
Town of Bowden
Town of Brooks
Town of Cochrane
Town of Coaldale
Town of Crossfield
Town of Didsbury
Town of Eckville
Town of Fort Macleod
Town of High River
Town of Innisfail
Town of Lacombe
Town of Magrath
Town of Nanton
Town of Okotoks
Town of Penhold
Town of Pincher Creek
Town of Ponoka
Town of Raymond
Town of Redcliff
Town of Rimbey
Town of Strathmore
Town of Sylvan Lake
Town of Trochu
Town of Vauxhall
Town of Vulcan
Village of Carbon
Village of Empress
Village of Irricana
Village of Longview
Village of Munson
Village of Standard
Village of Veteran
Bow River Irrigation District
Lethbridge Northern ID
Magrath Irrigation District
Mountain View ID
Raymond Irrigation District
Taber Irrigation District
Henry Kroeger RWSC

# APPENDIX C

## Sample Questionnaires for Municipalities

July 13, 2000 File: 448

Dear:

**SUBJECT: Future Water Use Projections**
**Year 2000 Review of Water Management in the South Saskatchewan River Basin**

Alberta Environment is conducting the *Year 2000 Review of Water Management in the South Saskatchewan River Basin*. To assist with this review, Hydroconsult and Canadian Resource Economics have been contracted by Alberta Environment to develop projections for population, water use, and effluent discharge (excluding water use by irrigation districts). Hydroconsult completed a similar study for Alberta Environment on a portion of the basin in 1999 (Highwood River and upper Little Bow River sub-basins).

The Terms of Reference of the study may be found on our website at www.hydroconsult.com/ssrbinfo.htm.

A critical component of this study is to obtain relevant data on population, water use and economic activity from the various jurisdictions in the basin. We therefore request your assistance in completing the attached questionnaire as completely as practical. This offers you the opportunity to present your existing and future plans for water use. Depending upon the data you have, you may wish to complete the questionnaire by various methods:

- by hand;
- hard copies or digital files of annual water reports; and/or
- entered on the Word and Excel files on the diskette attached.

To facilitate data transfer and significantly reduce our data processing, we would appreciate receiving the data either entered into the spreadsheet provided or alternatively copies of your own spreadsheets. The information may be returned to us in the enclosed self-addressed envelope or by e-mail to: ssrbinfo@hydroconsult.com.

If you have any questions, please do not hesitate to contact us or Bob Morrison of Alberta Environment at (403) 297-6462. Your assistance will help ensure that adequate water supplies are available in the future. Thank you.

Yours truly,

**HYDROCONSULT EN3 Services Ltd.**

D. L. Cooper

Dave L. Cooper, P. Eng.
Vice-President/Senior Project Manager

# YEAR 2000 REVIEW OF WATER MANAGEMENT IN THE SOUTH SASKATCHEWAN RIVER BASIN NON-DISTRICT WATER USE PROJECTIONS

# QUESTIONNAIRE FOR MUNICIPALITIES

**NOTE: IF ANY QUESTIONS ARE NOT APPLICABLE TO YOUR JURISDICTION, INDICATE BY N/A.**

## 1.0 BASIC DETAILS

1.1 Name of Municipality: _____

1.2 Name of person(s) completing this survey: _____

1.3 Position: _____ Phone: _____

1.4 E-mail: _____ Fax: _____

1.5 Please identify all of the unincorporated settlements (e.g., hamlets) within your municipality.

_____

_____

## 2.0 WATER WITHDRAWAL AND CONSUMPTION

2.1 Currently, what is the principal source(s) of water for your municipality (if river or creek, please provide name)? _____

2.2 What were the actual gross diversions (or withdrawals) from surface and groundwater sources by your municipality in 1000 $m^3$? Please **fill out as much of Table 1 as possible** (see hard copy attached or Excel file on diskette) or provide data sheets.

2.3 Please characterize (category of user, approximate number of consumers) any water users which your municipality currently services who are located outside your municipal boundaries.

_____

_____

_____

2.4 Does your municipality sell water at a standpipe? If so, what volume was sold in 1999?

_____

2.5 For each of the three-year periods below, please estimate the percentage of water consumed for each of the following categories of use.

| Use Category | 1991-1993 | 1994-1996 | 1997-1999 |
|---|---|---|---|
| Household/Municipal (including water cooperatives) | | | |
| Industrial | | | |
| Commercial | | | |
| Stockwatering | | | |
| Other Agricultural (parks, golf courses, schools, etc., but excluding district irrigation) | | | |
| Total | 100% | 100% | 100% |

2.6 How many water users are there in your municipality?

| Type of User | Number | Total Number of Households Supplied with Water |
|---|---|---|
| Water co-operatives | | |
| Water supply companies | | |
| Industries | | N/A |
| Households with individual wells or diversions | | |
| Other (please specify below) | | |

## 3.0 RETURN FLOW

3.1 Do you report return flows and related effluent loadings to Alberta Environment?
Yes ☐ No ☐ If yes, for what period? _____

3.2 Does all of the effluent released by your wastewater treatment plant become part of the return flow (or is some recycled through irrigation of golf courses, hay crops, tree farms, etc.)? Please list annual volumes, if applicable, for the last few years. If no data are available but water is known to be directed elsewhere, indicate - N/A.

| Recipient | Annual Effluent Volume (1000 $m^3$) | | | | |
|---|---|---|---|---|---|
| | 199 | 1996 | 1997 | 1998 | 1999 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

3.3 Does the return flow from your municipality enter the same water source where the withdrawal took place? If not, where does it go?

3.4 Is the equation: *Withdrawal = Consumptive Use + Return Flow* reasonably accurate for your operations on an annual basis? If not, please identify the approximate magnitude and source of any difference in this equation (e.g., losses due to evaporation, infiltration, storm water inflow).

## 4.0 LOADINGS IN THE EFFLUENT DISCHARGE

4.1 Other than septic fields, what type of wastewater treatment is used in your municipality?

4.2 We recognize that annual reports showing effluent loadings have likely been submitted to Alberta Environment. However, to reduce our data collection time, hard copies or digital files on effluent loadings from past years would be appreciated.

Please check box if data tables are attached. ☐

4.3 Are there any planned upgrades to your treatment plant? If so, please indicate expected date(s) for upgrading and expected changes (percentage reductions) in effluent loadings.

4.4 Does your municipality have any recent data on storm water quality? If so, please indicate average annual TSS loadings (tonnes/yr or mg/l and average flow) and receiving stream.

Check box if Alberta Environment has storm water quality and flow data from your municipality. ☐

## 5.0 EXISTING AND PROJECTED POPULATION

5.1 Please summarize the historical and projected population data available for your municipality in **Table 2** (see hard copy attached or Excel file on diskette).

5.2 What are established population projections for your municipality?
Year _____ Population _____
Year _____ Population _____

5.3 Have the projections in 5.2 above been discussed and adopted officially in your municipality?
Yes ☐ No ☐

5.4 What is the source/purpose for the projection(s) in 5.3 above (person, phone number or name of document and originating agency)?

_____

_____

5.5 Do you have an expected annual average growth rate for your municipality for, say, the next ten years? _____

## 6.0 ECONOMIC ACTIVITY

6.1 Do you have a brochure or some other written description of economic activity in your municipality? Yes ☐ No ☐
If yes, please mail a copy to us at the address shown on the last page.

6.2 Is there a website describing your municipality? Yes ☐ No ☐ If yes, at what address?

_____

6.3 Who/what are the three main private-sector employers currently in your municipality?

_____

_____

_____

6.4 Who/what are the three main non-irrigation water users currently in your community?

_____

_____

_____

6.5 Excluding household use, what new water users might there be in your municipality in the future?

_____

_____

_____

6.6 What new industries may locate in your municipality? Estimated year?

_____

_____

_____

6.7 How would you characterize the trend in water use in your municipality over the next ten years?

_____

_____

## 7.0 POLICY TOOLS FOR PROMOTING WATER CONSERVATION

7.1 Has your municipality actively discussed policies to reduce the growth in water consumption? If so, what policies have you considered? _____

_____

_____

7.2 Has your municipality taken measures to reduce water consumption? If so, what measures have you used? _____

_____

_____

7.3 Does your municipality have a target(s) for reducing water consumption? If so what is it?

_____

_____

_____

## 8.0 WATER SUPPLY AND WATER USE CONFLICTS

8.1 In your municipality is there currently any concern about the sources of water available for withdrawals? If so, please describe them. _____

_____

_____

8.2 In your municipality is there currently any concern over the quality of water used for withdrawals? If so, please describe them. _____

_____

_____

8.3 In your municipality is there currently any concern over the quality of the effluent discharged following waste treatment? If so, please describe them. _____

_____

_____

## 9.0 RELEVANT DOCUMENTS

9.1 Can you recommend any documents describing current and projected water use in your municipality that we should use? Please supply a copy of any relevant local documents that are available. _____

_____

_____

_____

_____

## 10.0 YOUR SUGGESTIONS/COMMENTS ON THIS STUDY

10.1 Please add suggestions/comments here:

_____
_____
_____
_____
_____
_____
_____

Thank you very much for your assistance. Alberta Environment will advise you of the results of our study and how copies of the completed report may be obtained or reviewed.

**Mailing address:**

Dave Cooper
Hydroconsult
3100 Bow Valley Square II,
205 – 5 Avenue S.W.,
Calgary, Alberta T2P 2V7

Phone: (403) 265-6958
Fax: (403) 263-9818
E-mail: davec@hydroconsult.com

## TABLE 2 - Historical & Projected Population

**Jurisdiction:** _____

| Year | Population | Data Source |
|---|---|---|
| **1990** | | |
| **1991** | | |
| **1992** | | |
| **1993** | | |
| **1994** | 420 | Provincial Census June '91 |
| **1995** | | |
| **1996** | | |
| **1997** | | |
| **1998** | 665 | Federal Census May '96 |
| **1999** | | |
| **2000** | | |
| **Projections (please provide date)** | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# APPENDIX D

## Tables

**TABLE D1 - HISTORICAL POPULATION DATA BY MUNICIPALITY AND SUB-BASIN**

| Main Sub-Basin | Minor Sub-Basin | CSD Name | CSD Type | % of CSD in subbasin | 1981 Population | 1986 Population | 1991 Population | 1996 Population |
|---|---|---|---|---|---|---|---|---|
| Red Deer River | RD1 | Bighorn No. 8 | MD | 31% | n/a | 336 | 355 | 387 |
| Red Deer River | RD1 | Burnstick Lake | SV | 100% | 0 | 0 | n/a | 4 |
| Red Deer River | RD1 | Caroline | VL | 100% | 436 | 364 | 407 | 472 |
| Red Deer River | RD1 | Clearwater No. 99 | MD | 13% | 1,224 | 1,310 | 1,348 | 1,452 |
| Red Deer River | RD1 | Mountain View County No. 17 | CM | 21% | 1,854 | 1,866 | 2,090 | 2,368 |
| Red Deer River | RD1 | Red Deer County No. 23 | CM | 6% | 842 | 862 | 933 | 1,062 |
| Red Deer River | RD1 | Sundre | T | 100% | 1,742 | 1,713 | 1,834 | 2,028 |
| | **RD1 Total** | | | | 6,098 | 6,451 | 6,966 | 7,773 |
| Red Deer River | RD1A | Bowden | T | 100% | 991 | 967 | 923 | 1,014 |
| Red Deer River | RD1A | Cremona | VL | 100% | 382 | 356 | 393 | 380 |
| Red Deer River | RD1A | Olds | T | 100% | 4,813 | 4,871 | 5,549 | 5,815 |
| Red Deer River | RD1A | Red Deer County No. 23 | CM | 47% | 6,346 | 6,496 | 7,028 | 7,998 |
| | **RD1A Total** | | | | 12,532 | 12,690 | 13,893 | 15,207 |
| Red Deer River | RD2 | Bighorn No. 8 | MD | 16% | n/a | 174 | 184 | 201 |
| Red Deer River | RD2 | Birchcliff | SV | 100% | 55 | 48 | 68 | 102 |
| Red Deer River | RD2 | Clearwater No. 99 | MD | 7% | 662 | 709 | 730 | 786 |
| Red Deer River | RD2 | Eckville | T | 100% | 871 | 853 | 899 | 901 |
| Red Deer River | RD2 | Half Moon Bay | SV | 100% | 33 | 43 | 51 | 53 |
| Red Deer River | RD2 | Innisfail | T | 100% | 5,247 | 5,535 | 5,700 | 6,116 |
| Red Deer River | RD2 | Jarvis Bay | SV | 100% | 63 | 58 | 33 | 83 |
| Red Deer River | RD2 | Lacombe County No. 14 | CM | 16% | 1,378 | 1,399 | 1,457 | 1,583 |
| Red Deer River | RD2 | Mountain View County No. 17 | CM | 36% | 3,179 | 3,199 | 3,582 | 4,060 |
| Red Deer River | RD2 | Norglenwold | SV | 100% | 86 | 107 | 186 | 281 |
| Red Deer River | RD2 | Penhold | T | 100% | 1,531 | 1,580 | 1,590 | 1,625 |
| Red Deer River | RD2 | Ponoka County No. 3 | CM | 8% | 598 | 619 | 632 | 665 |
| Red Deer River | RD2 | Red Deer | C | 100% | 46,393 | 54,425 | 58,145 | 60,075 |
| Red Deer River | RD2 | Rocky View No. 44 | MD | 7% | 1,124 | 1,136 | 1,293 | 1,516 |
| Red Deer River | RD2 | Sylvan Lake | T | 100% | 3,783 | 3,937 | 4,210 | 5,178 |
| Red Deer River | RD2 | Wetaskiwin County No. 10 | CM | 1% | 45 | 48 | 49 | 52 |
| | **RD2 Total** | | | | 65,048 | 73,870 | 78,809 | 83,276 |
| Red Deer River | RD3 | Bentley | VL | 100% | 831 | 841 | 840 | 987 |
| Red Deer River | RD3 | Blackfalds | T | 100% | 1,488 | 1,688 | 1,769 | 2,001 |
| Red Deer River | RD3 | Gull Lake | SV | 100% | 80 | 102 | 108 | 149 |
| Red Deer River | RD3 | Lacombe County No. 14 | CM | 27% | 2,325 | 2,361 | 2,460 | 2,671 |
| Red Deer River | RD3 | Parkland Beach | SV | 100% | 28 | 48 | 66 | 97 |
| Red Deer River | RD3 | Ponoka County No. 3 | CM | 32% | 2,422 | 2,507 | 2,558 | 2,693 |
| Red Deer River | RD3 | Red Deer County No. 23 | CM | 4% | 584 | 598 | 647 | 736 |
| Red Deer River | RD3 | Rimbey | T | 100% | 1,685 | 1,786 | 1,937 | 2,106 |
| Red Deer River | RD3 | Sunbreaker Cove | SV | 100% | n/a | 41 | 76 | 86 |
| Red Deer River | RD3 | Wetaskiwin County No. 10 | CM | 3% | 307 | 324 | 334 | 356 |
| | **RD3 Total** | | | | 9,750 | 10,297 | 10,795 | 11,883 |
| Red Deer River | RD4 | Alix | VL | 100% | 837 | 793 | 782 | 765 |
| Red Deer River | RD4 | Bashaw | T | 100% | 875 | 829 | 807 | 774 |
| Red Deer River | RD4 | Camrose County No. 22 | CM | 7% | 552 | 546 | 546 | 556 |
| Red Deer River | RD4 | Clive | VL | 100% | 364 | 356 | 414 | 517 |
| Red Deer River | RD4 | Delburne | VL | 100% | 574 | 577 | 564 | 641 |
| Red Deer River | RD4 | Lacombe County No. 14 | CM | 45% | 3,966 | 4,028 | 4,196 | 4,557 |
| Red Deer River | RD4 | Mirror | VL | 100% | 507 | 508 | 478 | 487 |
| Red Deer River | RD4 | Ponoka County No. 3 | CM | 7% | 538 | 557 | 569 | 599 |
| Red Deer River | RD4 | Red Deer County No. 23 | CM | 13% | 1,726 | 1,767 | 1,911 | 2,175 |
| Red Deer River | RD4 | Rochon Sands | SV | 100% | 39 | 31 | 37 | 86 |
| Red Deer River | RD4 | Stettler County No. 6 | CM | 17% | 860 | 877 | 887 | 892 |
| Red Deer River | RD4 | White Sands | SV | 100% | 2 | 2 | 21 | 49 |
| | **RD4 Total** | | | | 10,840 | 10,871 | 11,212 | 12,097 |
| Red Deer River | RD5 | Acme | VL | 100% | 468 | 457 | 527 | 600 |
| Red Deer River | RD5 | Badlands No. 7 | MD | 100% | 1,148 | 1,145 | 1,211 | 1,246 |
| Red Deer River | RD5 | Beiseker | VL | 100% | 582 | 503 | 605 | 708 |
| Red Deer River | RD5 | Big Valley | VL | 100% | 361 | 295 | 303 | 308 |
| Red Deer River | RD5 | Carbon | VL | 100% | 434 | 433 | 416 | 450 |
| Red Deer River | RD5 | Carstairs | T | 100% | 1,587 | 1,629 | 1,645 | 1,887 |
| Red Deer River | RD5 | Delia | VL | 100% | 211 | 208 | 171 | 208 |
| Red Deer River | RD5 | Didsbury | T | 100% | 3,097 | 3,184 | 3,358 | 3,553 |
| Red Deer River | RD5 | Drumheller | C | 100% | 6,528 | 6,366 | 6,277 | 6,587 |
| Red Deer River | RD5 | Elnora | VL | 100% | 256 | 245 | 265 | 247 |
| Red Deer River | RD5 | Halkirk | VL | 100% | 156 | 143 | 150 | 131 |
| Red Deer River | RD5 | Hanna | T | 100% | 2,806 | 3,020 | 2,996 | 3,001 |
| Red Deer River | RD5 | Irricana | VL | 100% | 558 | 669 | 812 | 823 |
| Red Deer River | RD5 | Kneehill No. 48 | MD | 100% | 4,895 | 4,996 | 4,712 | 4,887 |
| Red Deer River | RD5 | Linden | VL | 100% | 407 | 417 | 461 | 565 |
| Red Deer River | RD5 | Morrin | VL | 100% | 244 | 252 | 235 | 275 |

TABLE D1 - HISTORICAL POPULATION DATA BY MUNICIPALITY AND SUB-BASIN

| Main Sub-Basin | Minor Sub-Basin | CSD Name | CSD Type | % of CSD in subbasin | 1981 Population | 1986 Population | 1991 Population | 1996 Population |
|---|---|---|---|---|---|---|---|---|
| Red Deer River | RD5 | Mountain View County No. 17 | CM | 43% | 3,788 | 3,812 | 4,269 | 4,838 |
| Red Deer River | RD5 | Munson | VL | 100% | 148 | 152 | 159 | 201 |
| Red Deer River | RD5 | Newell County No. 4 | CM | 1% | 80 | 80 | 78 | 83 |
| Red Deer River | RD5 | Paintearth County No. 18 | CM | 18% | 452 | 441 | 421 | 419 |
| Red Deer River | RD5 | Red Deer County No. 23 | CM | 29% | 3,900 | 3,992 | 4,319 | 4,915 |
| Red Deer River | RD5 | Rocky View No. 44 | MD | 30% | 5,169 | 5,228 | 5,947 | 6,974 |
| Red Deer River | RD5 | Rockyford | VL | 100% | 329 | 293 | 318 | 346 |
| Red Deer River | RD5 | Special Area No. 2 | SA | 28% | 713 | 705 | 692 | 704 |
| Red Deer River | RD5 | Starland No. 47 | MD | 100% | 2,083 | 2,120 | 2,115 | 2,075 |
| Red Deer River | RD5 | Stettler County No. 6 | CM | 47% | 2,367 | 2,414 | 2,442 | 2,454 |
| Red Deer River | RD5 | Three Hills | T | 100% | 2,573 | 2,528 | 2,889 | 3,022 |
| Red Deer River | RD5 | Torrington | VL | 100% | 189 | 209 | 177 | 177 |
| Red Deer River | RD5 | Trochu | T | 100% | 880 | 892 | 907 | 958 |
| Red Deer River | RD5 | Wheatland County No. 16 | CM | 40% | 2,204 | 2,163 | 2,348 | 2,686 |
| | **RD5 Total** | | | | 48,613 | 48,991 | 51,225 | 55,329 |
| Red Deer River | RD6 | Acadia No. 34 | MD | 95% | 573 | 586 | 495 | 506 |
| Red Deer River | RD6 | Bassano | T | 100% | 1,200 | 1,186 | 1,190 | 1,272 |
| Red Deer River | RD6 | Brooks | T | 100% | 9,439 | 9,464 | 9,433 | 10,093 |
| Red Deer River | RD6 | Cereal | VL | 100% | 249 | 243 | 200 | 211 |
| Red Deer River | RD6 | Cypress No. 1 | MD | 2% | 108 | 110 | 114 | 123 |
| Red Deer River | RD6 | Duchess | VL | 100% | 429 | 430 | 477 | 693 |
| Red Deer River | RD6 | Empress | VL | 100% | 200 | 229 | 189 | 186 |
| Red Deer River | RD6 | Newell County No. 4 | CM | 54% | 3,313 | 3,293 | 3,224 | 3,442 |
| Red Deer River | RD6 | Oyen | T | 100% | 975 | 984 | 1,019 | 1,009 |
| Red Deer River | RD6 | Rosemary | VL | 100% | 328 | 321 | 337 | 332 |
| Red Deer River | RD6 | Special Area No. 2 | SA | 61% | 1,565 | 1,548 | 1,519 | 1,544 |
| Red Deer River | RD6 | Special Area No. 3 | SA | 53% | 908 | 909 | 879 | 844 |
| Red Deer River | RD6 | Wheatland County No. 16 | CM | 11% | 589 | 579 | 628 | 718 |
| | **RD6 Total** | | | | 19,877 | 19,881 | 19,704 | 20,973 |
| **Red Deer River Total** | | | | | 172,758 | 183,052 | 192,604 | 206,538 |
| Bow River | B1 | Banff | T | 100% | n/a | 5,197 | 5,688 | 6,098 |
| Bow River | B1 | Bighorn No. 8 | MD | 47% | n/a | 522 | 552 | 602 |
| Bow River | B1 | Canmore | T | 100% | 3,484 | 4,182 | 5,681 | 8,354 |
| Bow River | B1 | Ghost Lake | SV | 100% | 42 | 28 | 53 | 63 |
| Bow River | B1 | Improvement District No.5 | ID | 40% | 56 | 113 | 169 | 266 |
| Bow River | B1 | Improvement District No.9 | ID | 100% | 4,627 | 6,063 | 916 | 1,305 |
| Bow River | B1 | Stoney 142, 143, 144 | R | 100% | 1,226 | n/a | 1,993 | 2,157 |
| Bow River | B1 | Waiparous | SV | 100% | 17 | 16 | 26 | 47 |
| | **B1 Total** | | | | 9,452 | 16,121 | 15,078 | 18,892 |
| Bow River | B2 | Bighorn No. 8 | MD | 4% | n/a | 48 | 51 | 56 |
| Bow River | B2 | Cochrane | T | 100% | 3,544 | 4,190 | 5,267 | 7,424 |
| Bow River | B2 | Rocky View No. 44 | MD | 18% | 3,077 | 3,112 | 3,540 | 4,152 |
| | **B2 Total** | | | | 6,621 | 7,351 | 8,858 | 11,632 |
| Bow River | B3 | Airdrie | C | 100% | 8,414 | 10,416 | 12,456 | 15,946 |
| Bow River | B3 | Calgary | C | 100% | 592,808 | 636,843 | 710,795 | 768,082 |
| Bow River | B3 | Crossfield | T | 100% | 1,224 | 1,402 | 1,739 | 1,899 |
| Bow River | B3 | Mountain View County No. 17 | CM | 0% | 18 | 18 | 20 | 23 |
| Bow River | B3 | Rocky View No. 44 | MD | 14% | 2,438 | 2,465 | 2,804 | 3,289 |
| | **B3 Total** | | | | 604,901 | 651,144 | 727,814 | 789,239 |
| Bow River | B4 | Chestermere | T | 100% | 487 | 590 | 926 | 1,911 |
| Bow River | B4 | Foothills No. 31 | MD | 13% | 1,267 | 1,231 | 1,429 | 1,797 |
| Bow River | B4 | Rocky View No. 44 | MD | 7% | 1,245 | 1,259 | 1,432 | 1,679 |
| Bow River | B4 | Tsuu T'ina | R | 80% | 849 | n/a | 1,995 | 1,207 |
| | **B4 Total** | | | | 3,848 | 3,080 | 5,783 | 6,594 |
| Bow River | B5 | Foothills No. 31 | MD | 3% | 329 | 320 | 371 | 466 |
| Bow River | B5 | Rocky View No. 44 | MD | 3% | 501 | 507 | 577 | 676 |
| Bow River | B5 | Vulcan County No. 2 | CM | 0% | 11 | 11 | 11 | 11 |
| Bow River | B5 | Wheatland County No. 16 | CM | 2% | 121 | 119 | 129 | 148 |
| | **B5 Total** | | | | 963 | 956 | 1,088 | 1,302 |
| Bow River | B6 | Arrowwood | VL | 100% | 156 | 137 | 142 | 163 |
| Bow River | B6 | Foothills No. 31 | MD | 3% | 310 | 301 | 349 | 439 |
| Bow River | B6 | Gleichen | T | 100% | 381 | 327 | 331 | 335 |
| Bow River | B6 | Hussar | VL | 100% | 175 | 167 | 146 | 157 |
| Bow River | B6 | Newell County No. 4 | CM | 1% | 37 | 37 | 36 | 39 |
| Bow River | B6 | Siksika No. 146 | R | 100% | 1,963 | 2,303 | 2,106 | 2,678 |
| Bow River | B6 | Standard | VL | 100% | 379 | 331 | 329 | 366 |
| Bow River | B6 | Strathmore | T | 100% | 3,014 | 3,544 | 4,190 | 5,282 |
| Bow River | B6 | Vulcan | T | 100% | 1,495 | 1,420 | 1,466 | 1,537 |
| Bow River | B6 | Vulcan County No. 2 | CM | 34% | 1,250 | 1,232 | 1,229 | 1,290 |
| Bow River | B6 | Wheatland County No. 16 | CM | 47% | 2,595 | 2,547 | 2,765 | 3,162 |
| | **B6 Total** | | | | 11,754 | 12,345 | 13,090 | 15,448 |

**TABLE D1 - HISTORICAL POPULATION DATA BY MUNICIPALITY AND SUB-BASIN**

| Main Sub-Basin | Minor Sub-Basin | CSD Name | CSD Type | % of CSD in subbasin | 1981 Population | 1986 Population | 1991 Population | 1996 Population |
|---|---|---|---|---|---|---|---|---|
| Bow River | B7 | Cypress No. 1 | MD | 8% | 391 | 398 | 412 | 444 |
| Bow River | B7 | Newell County No. 4 | CM | 44% | 2,726 | 2,709 | 2,652 | 2,832 |
| Bow River | B7 | Taber No. 14 | MD | 19% | 1,057 | 999 | 1,005 | 1,067 |
| Bow River | B7 | Tilley | VL | 100% | 345 | 362 | 322 | 368 |
| Bow River | B7 | Vulcan County No. 2 | CM | 11% | 397 | 391 | 390 | 410 |
| | **B7 Total** | | | | 4,915 | 4,859 | 4,781 | 5,120 |
| Bow River | ELBOW | Foothills No. 31 | MD | 0% | 10 | 9 | 11 | 14 |
| Bow River | ELBOW | Improvement District No.5 | ID | 30% | 42 | 85 | 127 | 200 |
| Bow River | ELBOW | Rocky View No. 44 | MD | 8% | 1,366 | 1,381 | 1,571 | 1,843 |
| Bow River | ELBOW | Tsuu T'ina | R | 20% | 212 | n/a | 499 | 302 |
| | **ELBOW Total** | | | | 1,629 | 1,475 | 2,208 | 2,358 |
| Bow River | HIGH | Black Diamond | T | 100% | 1,444 | 1,486 | 1,623 | 1,811 |
| Bow River | HIGH | Eden Valley 216 | R | 100% | 353 | 432 | 370 | 432 |
| Bow River | HIGH | Foothills No. 31 | MD | 56% | 5,387 | 5,235 | 6,078 | 7,639 |
| Bow River | HIGH | High River | T | 100% | 4,845 | 5,112 | 6,269 | 7,359 |
| Bow River | HIGH | Improvement District No.5 | ID | 30% | 42 | 85 | 127 | 200 |
| Bow River | HIGH | Longview | VL | 100% | 301 | 276 | 271 | 303 |
| Bow River | HIGH | Okotoks | T | 100% | 3,847 | 5,226 | 6,723 | 8,510 |
| Bow River | HIGH | Ranchland No. 66 | MD | 2% | 0 | 0 | 2 | 2 |
| Bow River | HIGH | Turner Valley | T | 100% | 1,311 | 1,271 | 1,352 | 1,527 |
| Bow River | HIGH | Willow Creek No. 26 | MD | 0% | 18 | 19 | 19 | 20 |
| | **HIGH Total** | | | | 17,548 | 19,141 | 22,834 | 27,803 |
| **Bow River Total** | | | | | 661,631 | 716,472 | 801,534 | 878,387 |
| | | | **OLDMAN RIVER BASIN** | | | | | |
| Oldman River | BELLY | Blood 148 | R | 80% | 3,102 | 3,265 | 3,210 | 3,461 |
| Oldman River | BELLY | Cardston No. 6 | MD | 20% | 837 | 862 | 876 | 890 |
| Oldman River | BELLY | Hillspring | VL | 100% | 200 | 243 | 238 | 220 |
| | **BELLY Total** | | | | 4,139 | 4,370 | 4,324 | 4,571 |
| Oldman River | LBR | Barons | VL | 100% | 315 | 290 | 262 | 285 |
| Oldman River | LBR | Blackie | VL | 100% | 298 | 266 | 303 | 301 |
| Oldman River | LBR | Carmangay | VL | 100% | 266 | 240 | 251 | 258 |
| Oldman River | LBR | Cayley | VL | 100% | 194 | 202 | 229 | 334 |
| Oldman River | LBR | Champion | VL | 100% | 339 | 350 | 351 | 362 |
| Oldman River | LBR | Foothills No. 31 | MD | 25% | 2,379 | 2,312 | 2,684 | 3,374 |
| Oldman River | LBR | Lethbridge County No. 26 | CM | 29% | 2,390 | 2,405 | 2,457 | 2,703 |
| Oldman River | LBR | Lomond | VL | 100% | 180 | 177 | 167 | 170 |
| Oldman River | LBR | Milo | VL | 100% | 100 | 117 | 104 | 117 |
| Oldman River | LBR | Nanton | T | 100% | 1,641 | 1,562 | 1,589 | 1,665 |
| Oldman River | LBR | Nobleford | VL | 100% | 534 | 531 | 517 | 558 |
| Oldman River | LBR | Ranchland No. 66 | MD | 1% | 0 | 0 | 2 | 2 |
| Oldman River | LBR | Stavely | T | 100% | 504 | 454 | 478 | 453 |
| Oldman River | LBR | Vulcan County No. 2 | CM | 42% | 1,573 | 1,550 | 1,547 | 1,623 |
| Oldman River | LBR | Willow Creek No. 26 | MD | 33% | 1,486 | 1,552 | 1,563 | 1,677 |
| | **LBR Total** | | | | 12,198 | 12,009 | 12,503 | 13,882 |
| Oldman River | O1 | Cowley | VL | 100% | 304 | 290 | 277 | 273 |
| Oldman River | O1 | Crowsnest Pass | T | 100% | 7,302 | 6,912 | 6,680 | 6,356 |
| Oldman River | O1 | Pincher Creek | T | 100% | 3,757 | 3,806 | 3,660 | 3,659 |
| Oldman River | O1 | Pincher Creek No. 9 | MD | 66% | 1,959 | 2,041 | 2,060 | 2,094 |
| Oldman River | O1 | Ranchland No. 66 | MD | 59% | n/a | n/a | 69 | 64 |
| Oldman River | O1 | Willow Creek No. 26 | MD | 1% | 41 | 43 | 43 | 46 |
| | **O1 Total** | | | | 13,363 | 13,092 | 12,788 | 12,491 |
| Oldman River | O2 | Cardston No. 6 | MD | 4% | 180 | 186 | 189 | 192 |
| Oldman River | O2 | Fort MacLeod | T | 100% | 3,144 | 3,123 | 3,112 | 3,034 |
| Oldman River | O2 | Lethbridge County No. 26 | CM | 9% | 698 | 703 | 718 | 790 |
| Oldman River | O2 | Peigan 147 | R | 100% | 1,446 | n/a | 1,272 | 1,662 |
| Oldman River | O2 | Pincher Creek No. 9 | MD | 15% | 439 | 458 | 462 | 469 |
| Oldman River | O2 | Willow Creek No. 26 | MD | 20% | 897 | 937 | 943 | 1,012 |
| | **O2 Total** | | | | 6,804 | 5,406 | 6,695 | 7,159 |
| Oldman River | O3 | Coalhurst | T | 100% | 885 | 1,252 | 1,322 | 1,439 |
| Oldman River | O3 | Lethbridge | C | 100% | 54,558 | 58,841 | 60,974 | 63,053 |
| Oldman River | O3 | Lethbridge County No. 26 | CM | 29% | 2,415 | 2,430 | 2,482 | 2,731 |
| Oldman River | O3 | Picture Butte | T | 100% | 1,409 | 1,576 | 1,563 | 1,669 |
| | **O3 Total** | | | | 59,267 | 64,099 | 66,341 | 68,892 |
| Oldman River | O4 | Barnwell | VL | 100% | 365 | 402 | 492 | 552 |
| Oldman River | O4 | Coaldale | T | 100% | 4,651 | 4,796 | 5,310 | 5,731 |
| Oldman River | O4 | Lethbridge County No. 26 | CM | 26% | 2,127 | 2,141 | 2,186 | 2,406 |
| Oldman River | O4 | Taber | T | 100% | 6,028 | 6,382 | 6,664 | 7,214 |
| Oldman River | O4 | Taber No. 14 | MD | 67% | 3,757 | 3,551 | 3,573 | 3,793 |
| Oldman River | O4 | Vauxhall | T | 100% | 1,049 | 991 | 977 | 1,011 |
| Oldman River | O4 | Vulcan County No. 2 | CM | 13% | 478 | 472 | 471 | 494 |
| Oldman River | O4 | Warner County No. 5 | CM | 2% | 55 | 57 | 59 | 57 |
| | **O4 Total** | | | | 18,511 | 18,792 | 19,732 | 21,258 |

**TABLE D1 - HISTORICAL POPULATION DATA BY MUNICIPALITY AND SUB-BASIN**

| Main Sub-Basin | Minor Sub-Basin | CSD Name | CSD Type | % of CSD in subbasin | 1981 Population | 1986 Population | 1991 Population | 1996 Population |
|---|---|---|---|---|---|---|---|---|
| Oldman River | ST-M | Blood 148 | R | 20% | 775 | 816 | 803 | 865 |
| Oldman River | ST-M | Cardston | T | 100% | 3,267 | 3,497 | 3,480 | 3,417 |
| Oldman River | ST-M | Cardston No. 6 | MD | 50% | 2,142 | 2,205 | 2,241 | 2,278 |
| Oldman River | ST-M | Lethbridge County No. 26 | CM | 2% | 156 | 157 | 160 | 177 |
| Oldman River | ST-M | Magrath | T | 100% | 1,576 | 1,637 | 1,752 | 1,867 |
| Oldman River | ST-M | Warner County No. 5 | CM | 1% | 42 | 43 | 44 | 43 |
| | **ST-M Total** | | | | 7,958 | 8,355 | 8,480 | 8,646 |
| Oldman River | ST-M-SUB | Cardston No. 6 | MD | 0% | 9 | 9 | 9 | 9 |
| Oldman River | ST-M-SUB | Cypress No. 1 | MD | 2% | 89 | 91 | 94 | 102 |
| Oldman River | ST-M-SUB | Forty Mile County No. 8 | CM | 36% | 1,229 | 1,187 | 1,137 | 1,150 |
| Oldman River | ST-M-SUB | Lethbridge County No. 26 | CM | 1% | 90 | 91 | 93 | 102 |
| Oldman River | ST-M-SUB | Raymond | T | 100% | 2,837 | 2,958 | 3,130 | 3,056 |
| Oldman River | ST-M-SUB | Stirling | VL | 100% | 688 | 796 | 799 | 874 |
| Oldman River | ST-M-SUB | Warner | VL | 100% | 477 | 435 | 412 | 421 |
| Oldman River | ST-M-SUB | Warner County No. 5 | CM | 47% | 1,623 | 1,679 | 1,725 | 1,670 |
| | **ST-M-SUB Total** | | | | 7,042 | 7,246 | 7,398 | 7,384 |
| Oldman River | WAT | Cardston No. 6 | MD | 9% | 391 | 402 | 409 | 415 |
| Oldman River | WAT | Glenwood | VL | 100% | 259 | 304 | 285 | 295 |
| Oldman River | WAT | Improvement District No.4 | ID | 100% | n/a | n/a | 167 | 279 |
| Oldman River | WAT | Pincher Creek No. 9 | MD | 19% | 570 | 594 | 599 | 609 |
| Oldman River | WAT | Willow Creek No. 26 | MD | 10% | 462 | 483 | 486 | 522 |
| | **WAT Total** | | | | 1,681 | 1,783 | 1,946 | 2,120 |
| Oldman River | WILL | Claresholm | T | 100% | 3,493 | 3,382 | 3,297 | 3,427 |
| Oldman River | WILL | Granum | T | 100% | 399 | 352 | 343 | 337 |
| Oldman River | WILL | Ranchland No. 66 | MD | 25% | n/a | n/a | 29 | 27 |
| Oldman River | WILL | Willow Creek No. 26 | MD | 36% | 1,626 | 1,699 | 1,710 | 1,836 |
| | **WILL Total** | | | | 5,518 | 5,433 | 5,379 | 5,627 |
| **Oldman River Total** | | | | | 136,480 | 140,584 | 145,587 | 152,031 |
| South Sask River | SS1 | Bow Island | T | 100% | 1,491 | 1,650 | 1,484 | 1,688 |
| South Sask River | SS1 | Burdett | VL | 100% | 220 | 278 | 239 | 286 |
| South Sask River | SS1 | Cypress No. 1 | MD | 31% | 1,474 | 1,501 | 1,553 | 1,675 |
| South Sask River | SS1 | Foremost | VL | 100% | 568 | 595 | 582 | 556 |
| South Sask River | SS1 | Forty Mile County No. 8 | CM | 49% | 1,698 | 1,641 | 1,571 | 1,589 |
| South Sask River | SS1 | Grassy Lake | VL | 100% | 201 | 235 | 206 | 327 |
| South Sask River | SS1 | Irvine | T | 100% | 360 | 301 | 326 | 330 |
| South Sask River | SS1 | Medicine Hat | C | 100% | 40,700 | 41,823 | 43,625 | 46,783 |
| South Sask River | SS1 | Newell County No. 4 | CM | 0% | 19 | 18 | 18 | 19 |
| South Sask River | SS1 | Redcliff | T | 100% | 3,876 | 3,834 | 3,768 | 4,104 |
| South Sask River | SS1 | Taber No. 14 | MD | 13% | 749 | 708 | 712 | 756 |
| South Sask River | SS1 | Warner County No. 5 | CM | 5% | 180 | 186 | 191 | 185 |
| | **SS1 Total** | | | | 51,535 | 52,770 | 54,276 | 58,299 |
| South Sask River | SS2 | Cypress No. 1 | MD | 34% | 1,582 | 1,611 | 1,667 | 1,799 |
| South Sask River | SS2 | Special Area No. 2 | SA | 4% | 95 | 94 | 92 | 94 |
| | **SS2 Total** | | | | 1,677 | 1,705 | 1,759 | 1,892 |
| **South Sask River Total** | | | | | 53,213 | 54,475 | 56,035 | 60,192 |
| **Grand Total** | | | | | 1,024,082 | 1,094,584 | 1,195,759 | 1,297,147 |

Notes: Towns may straddle sub-basin boundaries. Water use transfers between sub-basins are described later.
Where the population of a municipality was split into two or more sub-basins, the totals may be slightly higher or lower due to rounding.

**Table D2 - LISTING OF CONSTRUCTION PROJECTS BY CENSUS DIVISION**

| Major Projects | Sector | Location | Cost ($million) | No. of Projects | Status |
|---|---|---|---|---|---|
| *Census Division No. 1 (Medicine Hat)* | | | | | |
| Projects over $2 Million | | | | | |
| Wheat Processing Plant | A | Bow Island | 80.0 | 1 | Proposed |
| Power Plant | L | Medicine Hat | 57.0 | 1 | Under construction |
| Plant Expansion | J | Medicine Hat | 28.0 | 1 | Under construction |
| Hog Production Operation | A | Forty Mile County | 41.7 | 1 | Proposed |
| North Suffield Gas Pipeline | K | Cypress County | 22.3 | 1 | Announced |
| New Theatre/Gallery/Museum | O | Medicine Hat | 20.0 | 1 | Proposed |
| Leisure Centre | O | Medicine Hat | 17.0 | 1 | Nearing completion |
| Defence Construction | F | Cypress County (CFB) | 4.7 | 1 | Announced |
| Defence Construction | E | Cypress County (CFB) | 2.5 | 1 | Proposed |
| Defence Construction | F | Cypress County (CFB) | 2.1 | 1 | Proposed |
| | Total Inventory of Projects | | 286.8 | 26 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | A, L, O |
| *Census Division No. 2 (Lethbridge)* | | | | | |
| Projects over $2 Million | | | | | |
| French Fry Plant | A | County of Lethbridge | 93.9 | 1 | Completed |
| Shopping Centre Development | C | Lethbridge | 43.0 | 1 | Proposed |
| Library Info Network Centre | F | Lethbridge | 37.0 | 1 | Under construction |
| Federal Research Centre | A | Lethbridge | 36.0 | 1 | Announced |
| Border Crossing Centre | F | Coutts | 35.0 | 1 | Announced |
| Water Sys. Improvements | E | Lethbridge | 26.0 | 1 | Proposed |
| City Hall | F | Lethbridge | 20.0 | 1 | Completed |
| Convention Centre | O | Lethbridge | 20.0 | 1 | Proposed |
| Flour Milling & Pasta Proc. | A | Milk River | 20.0 | 1 | Proposed |
| Sanitary Collection System | E | Lethbridge | 16.0 | 1 | Proposed |
| | Total Inventory of Projects | | 555.4 | 95 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | F, A, E |
| *Census Division No. 3 (Fort Macleod)* | | | | | |
| Projects over $2 Million | | | | | |
| Reservoir Development | E | M.D. of Willow Creek | 78.0 | 1 | Under construction |
| Dam Spillway Replacement | E | M.D. of Cardston | 57.0 | 1 | Under construction |
| Hydroelectric Power Plant | L | M.D. of Pincher Creek | 33.6 | 1 | |
| Wellness Centre | C | M.D. of Pincher Creek | 14.0 | 1 | Proposed |
| Hydroelectric Power Plant | L | M.D. of Cardston | 12.5 | 1 | Completed |
| Commercial Greenhouse | A | M.D. of Willow Creek | 3.0 | 1 | Proposed |
| Sewage Plant Upgrades | E | Nanton | 2.8 | 1 | Proposed |
| Bouvry Facility Expansion | A | Fort Macleod | 2.0 | 1 | Announced |
| Cheese Plant Expansion | A | Glenwood | 2.0 | 1 | Proposed |
| | Total Inventory of Projects | | 217.2 | 31 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | E, L, C |
| *Census Division No. 4 (Hanna)* | | | | | |
| Projects over $2 Million | | | | | |
| Natural Gas Liquids Expansion | I | Empress | 120.0 | 1 | Nearing completion |
| Gas Gathering System | K | Cessford | 3.0 | 1 | Announced |
| Hwy. 9 Pavement Overlay | E | Special Area 2 | 3.0 | 1 | Completed |
| AB Infrastruct. Hwy. Paving | E | Consort | 2.8 | 1 | Announced |
| AB Infrastructure Paving | E | Red Deer River | 2.7 | 1 | Announced |
| | Total Inventory of Projects | | 133.0 | 7 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | I, E, K |
| *Census Division No. 5 (Drumheller)* | | | | | |
| Projects over $2 Million | | | | | |
| Nat. Gas fired Generating Plant | L | Wheatland County | 100.0 | 1 | Proposed |
| Nat. Gas fired Generating Plant | L | Wheatland County | 75.0 | 1 | Announced |
| Hospital | F | Drumheller | 31.0 | 1 | Under construction |
| Swine Operation | A | Standard | 28.0 | 1 | Announced |
| Res. & Com. Development | M | Drumheller | 25.0 | 1 | Under construction |
| Sewage Lift Station | E | Wheatland County | 23.0 | 1 | Announced |
| Full Service Facility | A | Vulcan | 17.0 | 1 | Under construction |
| High School & Comm. Centre | F | Strathmore | 15.2 | 1 | Announced |
| Historical Park | O | Gleichen | 15.0 | 1 | Proposed |
| Shopping Centre | C | Drumheller | 12.0 | 1 | Nearing completion |
| | Total Inventory of Projects | | 397.4 | 52 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | L, E, A |
| *Census Division No. 6 (Calgary)* | | | | | |
| Projects over $2 Million | | | | | |
| Airport Improvements | E | Calgary | 650.0 | 1 | Under construction |
| Business Centre | C | Airdrie | 500.0 | 1 | Under construction |
| Shopping Centre Expansion | C | Calgary | 300.0 | 1 | Under construction |
| Office Tower | C | Calgary | 260.0 | 1 | Under construction |
| Straddle Plant | I | Calgary | 250.0 | 1 | Under construction |
| New hospital | F | Calgary | 220.0 | 1 | Proposed |
| Gas fired Power Plant | L | Calgary | 220.0 | 1 | Proposed |
| LRT Extension | E | Calgary | 175.0 | 1 | Under construction |
| LRT Extension | E | Calgary | 131.0 | 1 | Announced |
| Entertainment Facility | O | Foothills | 130.0 | 1 | Under construction |
| | Total Inventory of Projects | | 5918.0 | 272 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | E, C, O |

**Table D2 - LISTING OF CONSTRUCTION PROJECTS BY CENSUS DIVISION**
**(continued)**

| Major Projects | Sector | Location | Cost ($million) | No. of Projects | Status |
|---|---|---|---|---|---|
| *Census Division No. 7 (Stettler)* | | | | | |
| Projects over $2 Million | | | | | |
| Oil Battery & Gas Plant | I | Wainwright | 40.0 | 1 | Announced |
| Inland Grain Terminal | A | Provost | 10.0 | 1 | Proposed |
| Twin Arena Complex | E | Wainwright | 6.5 | 1 | Nearing completion |
| Adult Living Condos | M | Stettler | 4.0 | 1 | Under construction |
| Seniors Housing Complex | F | Daysland | 3.1 | 1 | Completed |
| Lodge Addition/Renovations | F | Wainwright | 2.7 | 1 | Nearing completion |
| Infrastructure | F | Chauvin | 2.6 | 1 | Proposed |
| Infrastructure | F | Wainwright | 2.4 | 1 | Proposed |
| Infrastructure | F | Coronation | 2.1 | 1 | Proposed |
| | Total Inventory of Projects | | 90.7 | 31 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | I, F, A |
| *Census Division No. 8 (Red Deer)* | | | | | |
| Projects over $2 Million | | | | | |
| Ethylene Plant | B | Joffre | 1100.0 | 1 | Nearing completion |
| Linear Alpha Olefins Plant | B | Joffre | 400.0 | 1 | Under construction |
| Polyethylene Plant | B | Joffre | 395.0 | 1 | Under construction |
| Polyethylene Plant | B | Prentiss | 316.0 | 1 | Nearing completion |
| Railyard | E | Prentiss | 150.0 | 1 | Nearing completion |
| Hospital Redevelopment | F | Ponoka | 80.0 | 1 | Announced |
| Retail Development | C | Red Deer | 50.0 | 1 | Announced |
| RV Park/Campground | O | Red Deer | 35.0 | 1 | Announced |
| Collicutt Recreation Complex | O | Red Deer | 29.8 | 1 | Under construction |
| | Total Inventory of Projects | | 2944.6 | 115 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | B, E, F |
| *Census Division No. 9 (Rocky Mountain House)* | | | | | |
| Projects over $2 Million | | | | | |
| Cement Plant | J | Rocky Mtn. House | 100.0 | 1 | Proposed |
| Facility Expansion | D | MD of Clearwater | 17.0 | 1 | Proposed |
| Infrastructure | F | Rocky Mtn. House | 7.9 | 1 | Announced |
| Seniors' Condo Apts. | M | Rocky Mtn. House | 3.0 | 1 | Completed |
| Road Upgrades | E | MD of Clearwater | 3.0 | 1 | Announced |
| Infrastructure - Hwy. Paving | E | MD of Clearwater | 2.7 | 1 | Announced |
| | Total Inventory of Projects | | 145.5 | 20 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | J, D, E |
| *Census Division No. 15 (Banff)* | | | | | |
| Projects over $2 Million | | | | | |
| Hotel/Resort Complex | O | Canmore | 270.0 | 1 | Completed |
| Three Sisters Resort | O | Canmore | 150.0 | 1 | Proposed |
| Hotel Expansion | O | Banff | 56.0 | 1 | Under construction |
| Conference Centre | O | Lake Louise | 45.0 | 1 | |
| Housing Development | O | Crowsnest Pass | 30.0 | 1 | Proposed |
| Resort Hotel | O | Canmore | 27.0 | 1 | Proposed |
| Canmore Crossing | C | Canmore | 25.0 | 1 | Proposed |
| Downtown Enhancement | E | Banff | 19.0 | 1 | Announced |
| Hotel Expansion | O | Jasper | 15.0 | 1 | Under construction |
| Plant Upgrade | J | MD of Bighorn | 19.8 | 1 | Proposed |
| | Total Inventory of Projects | | 707.6 | 26 | |
| | Total Inventory - Top 3 Categories of Projects by Valu | | | | O, E, C |

Source: http://albertafirst.com (website of Alberta Economic Development) as of Nov. 14, 2000

Notes:

(i) This table provides data on projects that have been recently completed, are under construction or are proposed;

(ii) Individual projects appearing in this table are valued at over $2 million;

(iii) Total inventory of projects refers to all projects recorded by Alberta Economic Development, both above and below $2 million;

(iv) Project categories are as follows:

| | |
|---|---|
| A Agriculture & Related | I Oil, Gas and Oilsands |
| B Chemicals & Petrochemicals | J Other Industrial |
| C Commercial/Retail | K Pipelines |
| D Forestry & Related | L Power |
| E Infrastructure | M Residential |
| F Institutional | N Telecommunications |
| G Manufacturing | O Tourism |
| H Mining | |

**Table D3 - HISTORICAL LIVESTOCK POPULATIONS BY CENSUS SUBDIVISIONS 1981-1996**

| County/MD | No. | Name | Year | Cattle&Calves | Pigs | Sheep&Lambs | Hens&Chickens |
|---|---|---|---|---|---|---|---|
| *County* | *2* | *Vulcan* | 1981 | 47,780 | 16,649 | 653 | 69,115 |
| | | | 1986 | 36,491 | 17,578 | 2,129 | 56,617 |
| | | | 1991 | 46,301 | 33,873 | 7,733 | 48,275 |
| | | | 1996 | 78,131 | 30,948 | 4,091 | 69,703 |
| *County* | *3* | *Ponoka* | 1981 | 138,224 | 33,835 | 6,344 | 61,209 |
| | | | 1986 | 129,937 | 48,784 | 4,656 | 25,741 |
| | | | 1991 | 162,182 | 50,523 | 5,276 | 25,087 |
| | | | 1996 | 185,752 | 71,498 | 6,149 | 81,538 |
| *County* | *4* | *Newell* | 1981 | 153,987 | 29,736 | 6,735 | 173,322 |
| | | | 1986 | 136,058 | 32,112 | 4,905 | 201,809 |
| | | | 1991 | 155,163 | 47,709 | 10,090 | 172,826 |
| | | | 1996 | 218,017 | 37,738 | 4,689 | 186,527 |
| *County* | *5* | *Warner* | 1981 | 71,911 | 21,412 | 7,278 | 128,125 |
| | | | 1986 | 51,076 | 30,098 | 3,898 | 104,369 |
| | | | 1991 | 70,235 | 33,226 | 3,905 | 131,984 |
| | | | 1996 | 73,050 | 45,260 | 2,838 | 205,435 |
| *County* | *6* | *Stettler* | 1981 | 91,895 | 19,724 | 1,518 | 165,976 |
| | | | 1986 | 87,904 | 25,741 | 1,971 | 132,062 |
| | | | 1991 | 104,405 | 27,124 | 4,944 | 138,043 |
| | | | 1996 | 119,733 | 25,798 | 4,177 | 137,616 |
| *County* | *8* | *Forty Mile* | 1981 | 65,942 | 16,278 | 2,738 | 131,985 |
| | | | 1986 | 53,600 | 28,517 | 2,599 | 167,088 |
| | | | 1991 | 63,026 | 34,993 | 2,118 | 140,949 |
| | | | 1996 | | | | |
| *County* | *10* | *Wetaskiwin* | 1981 | 102,631 | 27,924 | 3,638 | 78,527 |
| | | | 1986 | 90,731 | 37,126 | 3,809 | 64,182 |
| | | | 1991 | 117,825 | 27,832 | 5,958 | 84,420 |
| | | | 1996 | 143,704 | 29,425 | 4,467 | 102,586 |
| *County* | *14* | *Lacombe* | 1981 | 106,284 | 85,630 | 5,481 | 56,221 |
| | | | 1986 | 89,622 | 111,871 | 3,384 | 175,287 |
| | | | 1991 | 115,012 | 138,948 | 6,158 | 211,553 |
| | | | 1996 | 133,420 | 153,539 | 5,061 | 176,790 |
| *County* | *16* | *Wheatland* | 1981 | 156,173 | 24,868 | 4,226 | 198,627 |
| | | | 1986 | 93,168 | 30,271 | 3,605 | 314,757 |
| | | | 1991 | 133,428 | 50,093 | 8,813 | 268,156 |
| | | | 1996 | 124,424 | 40,579 | 7,977 | 224,081 |
| *County* | *17* | *Mountainview* | 1981 | 148,871 | 30,861 | 8,374 | 260,805 |
| | | | 1986 | 132,530 | 40,096 | 6,493 | 242,558 |
| | | | 1991 | 159,851 | 45,756 | 13,033 | 255,613 |
| | | | 1996 | 193,122 | 40,434 | 8,593 | x |
| *County* | *18* | *Paintearth* | 1981 | 57,763 | 8,705 | 536 | 29,288 |
| | | | 1986 | 51,052 | 10,257 | 1,356 | 22,224 |
| | | | 1991 | 64,976 | 15,348 | 909 | 25,817 |
| | | | 1996 | 74,709 | 13,210 | 948 | 33,223 |
| *County* | *22* | *Camrose* | 1981 | 68,801 | 40,350 | 2,431 | 555,849 |
| | | | 1986 | 66,274 | 37,485 | 2,166 | 560,639 |
| | | | 1991 | 79,096 | 44,091 | 6,699 | 603,149 |
| | | | 1996 | 93,560 | 37,831 | 7,190 | 650,751 |
| *County* | *23* | *Red Deer* | 1981 | 150,578 | 64,977 | 4,189 | 74,772 |
| | | | 1986 | 136,446 | 80,704 | 3,574 | 71,107 |
| | | | 1991 | 162,650 | 94,018 | 9,006 | 51,888 |
| | | | 1996 | 211,674 | 102,172 | 10,319 | 48,381 |
| *County* | *26* | *Lethbridge* | 1981 | 137,798 | 66,541 | 9,393 | 802,918 |
| | | | 1986 | 123,927 | 97,975 | 11,882 | 737,631 |
| | | | 1991 | 223,439 | 117,636 | 18,802 | 856,382 |
| | | | 1996 | 402,048 | 114,647 | 19,724 | 929,823 |
| *M.D.* | *1* | *Cypress* | 1981 | 126,463 | 9,525 | 1,108 | 61,985 |
| | | | 1986 | 116,457 | 13,683 | 2,007 | 46,641 |
| | | | 1991 | 117,732 | 18,324 | 2,950 | 60,701 |
| | | | 1996 | 149,663 | 28,694 | 3,426 | 28,700 |
| *M.D.* | *6* | *Cardston* | 1981 | 104,519 | 26,206 | 33,680 | 156,172 |
| | | | 1986 | 91,158 | 28,383 | 29,979 | 163,024 |
| | | | 1991 | 102,222 | 35,004 | 26,802 | 168,129 |
| | | | 1996 | 132,690 | 46,783 | 15,700 | 149,192 |
| *M.D.* | *8* | *Bighorn* | 1981 | 6,920 | 30 | - | 304 |
| | | | 1986 | na | na | na | na |
| | | | 1991 | na | na | na | na |
| | | | 1996 | 6,729 | x | x | 296 |

**Table D3 - HISTORICAL LIVESTOCK POPULATIONS BY CENSUS SUBDIVISIONS 1981-1996**
**(continued)**

| County/MD | No. | Name | Year | Cattle&Calves | Pigs | Sheep&Lambs | Hens&Chickens |
|---|---|---|---|---|---|---|---|
| *M.D.* | *9* | *Pincher Creek* | 1981 | 76,077 | 6,240 | 8,568 | 170,260 |
| | | | 1986 | 64,171 | 7,358 | 7,966 | 213,211 |
| | | | 1991 | 89,138 | 10,538 | 9,353 | 149,425 |
| | | | 1996 | 124,561 | 10,398 | 6,650 | 112,506 |
| *M.D.* | *14* | *Taber* | 1981 | 88,885 | 36,566 | 6,693 | 93,174 |
| | | | 1986 | 70,653 | 36,541 | 4,956 | 30,375 |
| | | | 1991 | 73,569 | 36,736 | 5,098 | 59,577 |
| | | | 1996 | 111,380 | 71,749 | 6,753 | 48,697 |
| *M.D.* | *26* | *Willow Creek* | 1981 | 128,099 | 27,191 | 4,561 | 142,316 |
| | | | 1986 | 110,345 | 32,234 | 6,690 | 91,284 |
| | | | 1991 | 132,558 | 32,247 | 17,884 | 167,886 |
| | | | 1996 | 186,160 | 35,793 | 11,539 | 200,295 |
| *M.D.* | *31* | *Foothills* | 1981 | 117,258 | 11,642 | 8,940 | 598,412 |
| | | | 1986 | 90,228 | 12,408 | 8,407 | x |
| | | | 1991 | 107,490 | 15,899 | 14,351 | 612,230 |
| | | | 1996 | 170,629 | 9,482 | 9,209 | 455,612 |
| *M.D.* | *34* | *Acadia* | 1981 | included in S.A. No. 3 | | | |
| | | | 1986 | included in S.A. No. 3 | | | |
| | | | 1991 | included in S.A. No. 3 | | | |
| | | | 1996 | 6,666 | 8,722 | x | 16,597 |
| *M.D.* | *44* | *Rockyview* | 1981 | 135,055 | 19,241 | 3,583 | 328,667 |
| | | | 1986 | 110,358 | 35,346 | 2,814 | 253,502 |
| | | | 1991 | 132,892 | 29,744 | 7,145 | 211,341 |
| | | | 1996 | 159,116 | 28,534 | 6,837 | 187,306 |
| *M.D.* | *47* | *Starland* | 1981 | 31,833 | 12,012 | 790 | na |
| | | | 1986 | 24,501 | 16,048 | 301 | 34,112 |
| | | | 1991 | 27,172 | 20,884 | 355 | 27,610 |
| | | | 1996 | 30,888 | 30,176 | 1,916 | 39,876 |
| *M.D.* | *48* | *Kneehill* | 1981 | 50,397 | 54,379 | 1,066 | 727,279 |
| | | | 1986 | 42,318 | 71,609 | 391 | 836,606 |
| | | | 1991 | 54,349 | 78,160 | 1,701 | 858,318 |
| | | | 1996 | 83,606 | 111,062 | 1,811 | 894,053 |
| *M.D.* | *66* | *Ranchlands* | 1981 | 6,503 | na | na | na |
| | | | 1986 | na | na | na | na |
| | | | 1991 | na | na | na | na |
| | | | 1996 | 13,032 | 0 | x | 271 |
| *M.D.* | *99* | *Clearwater* | 1981 | na | na | na | na |
| | | | 1986 | 93,550 | 16,743 | 5,238 | 72,222 |
| | | | 1991 | 125,016 | 20,569 | 8,421 | 51,811 |
| | | | 1996 | 140,358 | 22,657 | 3,770 | 47,763 |
| *Special Area* | *2* | | 1981 | 107,072 | 4,598 | na | 43,690 |
| | | | 1986 | 114,339 | 8,934 | 1,700 | 37,255 |
| | | | 1991 | 116,138 | 9,173 | 1,836 | 38,688 |
| | | | 1996 | 139,399 | x | 2,487 | 40,984 |
| *Special Area* | *3* | | 1981 | 63,921 | 10,456 | 1,104 | 25,805 |
| | | | 1986 | 60,334 | 15,330 | 29 | 83,887 |
| | | | 1991 | 58,379 | 21,309 | 887 | 26,883 |
| | | | 1996 | 65,290 | 15,765 | 962 | 8,152 |
| *Special Area* | *4* | | 1981 | 76,199 | 3,096 | na | 14,836 |
| | | | 1986 | 75,102 | 5,872 | 305 | 27,925 |
| | | | 1991 | 78,008 | 8,344 | 2,083 | 5,563 |
| | | | 1996 | 91,439 | x | 1,915 | 7,445 |
| *I.D.* | *15* | | 1981 | 16,750 | 5,236 | 701 | 11,840 |
| | | | 1986 | na | na | na | na |
| | | | 1991 | 23,804 | 4,458 | 3,140 | 8,538 |
| | | | 1996 | na | na | na | na |
| Total of all of Above | | | 1981 | 2,634,589 | 713,908 | 134,328 | 5,161,479 |
| | | | 1986 | 2,342,330 | 929,104 | 127,210 | 4,766,115 |
| | | | 1991 | 2,896,056 | 1,102,559 | 205,450 | 5,460,842 |
| | | | 1996 | 3,662,950 | 1,162,894 | 159,198 | 5,083,928 |

Notes: x signifies confidential
Table does not include data for the City of Calgary
Source: Statistics Canada Census of Agriculture - 1981, 1986, 1991 and 1996

## TABLE D4 - Number of Current Non-Irrigation Water Licences (1996)

| BASIN | Sub-basin | STOCKWATERING | OTHER AGRICULTURAL (Non-Irrigation) | MUNICIPAL | INDUSTRIAL | WATER MANAGEMENT | TOTAL |
|---|---|---|---|---|---|---|---|
| Red Deer River | RDR1 | 52 | 6 | 14 | 18 | 13 | 103 |
| | RDR2 | 497 | 27 | 62 | 62 | 58 | 706 |
| | RDR3 | 273 | 26 | 37 | 28 | 48 | 412 |
| | RDR4 | 315 | 20 | 30 | 23 | 21 | 409 |
| | RDR5 | 1,244 | 101 | 147 | 42 | 81 | 1,615 |
| | RDR6 | 703 | 82 | 19 | 7 | 29 | 840 |
| | Sub-total | 3,084 | 262 | 309 | 180 | 250 | 4,085 |
| % of Total in Red Deer River basin | | 75.5 | 6.4 | 7.6 | 4.4 | 6.1 | |
| Bow River | B1 | 17 | 9 | 47 | 24 | 12 | 109 |
| | B2 | 80 | 11 | 24 | 13 | 10 | 138 |
| | B3 | 107 | 38 | 69 | 15 | 25 | 254 |
| | B4 | 67 | 13 | 66 | 27 | 15 | 188 |
| | B5 | 27 | 2 | 1 | 3 | 3 | 36 |
| | B6 | 241 | 17 | 50 | 18 | 21 | 347 |
| | B7 | 106 | 8 | 15 | 17 | 8 | 154 |
| | Elbow | 51 | 17 | 57 | 12 | 8 | 145 |
| | Highwood | 306 | 20 | 65 | 21 | 23 | 435 |
| | Sub-total | 1,002 | 135 | 394 | 150 | 125 | 1,806 |
| % of Total in Bow River basin | | 55.5 | 7.5 | 21.8 | 8.3 | 6.9 | |
| Oldman River | O1 | 217 | 40 | 55 | 14 | 28 | 354 |
| | O2 | 194 | 13 | 46 | 16 | 9 | 278 |
| | O3 | 9 | 0 | 2 | 4 | 13 | 28 |
| | O4 | 43 | 5 | 8 | 5 | 10 | 71 |
| | Waterton | 107 | 2 | 20 | 5 | 5 | 139 |
| | Belly | 54 | 7 | 14 | 3 | 16 | 94 |
| | St. Mary | 212 | 12 | 48 | 25 | 21 | 318 |
| | St. Mary Sub | 421 | 10 | 22 | 6 | 19 | 478 |
| | Willow | 237 | 3 | 5 | 1 | 12 | 258 |
| | L. Bow | 374 | 11 | 53 | 18 | 35 | 491 |
| | Sub-total | 1,868 | 103 | 273 | 97 | 168 | 2,509 |
| % of Total in Oldman River basin | | 74.5 | 4.1 | 10.9 | 3.9 | 6.7 | |
| South Saskatchewan River | SS1 | 1,528 | 0 | 27 | 12 | 35 | 1,602 |
| | SS2 | 164 | 3 | 10 | 2 | 0 | 179 |
| | Sub-total | 1,692 | 3 | 37 | 14 | 35 | 1,781 |
| | | | | | | | |
| **Basin Total** | | 7,646 | 503 | 1,013 | 441 | 578 | 10,181 |
| **Percent of Basin Total** | | 75.1 | 4.9 | 9.9 | 4.3 | 5.7 | |

# TABLE D5a RED DEER RIVER BASIN

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | RED DEER 1 | | | | RED DEER 2 | | | | RED DEER 3 | | | | RED DEER 4 | | | | RED DEER 5 | | | | RED DEER 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 221 | 127 | 94 | 0 | 2,110 | 1,800 | 310 | 0 | 1,496 | 1,367 | 129 | 0 | 1,853 | 1,227 | 625 | 0 | 16,457 | 8,039 | 8,418 | 0 | 8,045 | 2,641 | 5,400 | 4 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 86 | 78 | 8 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 2,515 | 0 | 123 | 2,392 | 397 | 248 | 149 | 0 | 9 | 8 | 1 | 0 | 89 | 36 | 38 | 15 | 185 | 58 | 127 | 0 | 0 | 0 | 0 | 0 |
| | Gardens | 1 | 1 | 0 | 0 | 242 | 239 | 2 | 0 | 92 | 90 | 2 | 0 | 38 | 38 | 0 | 0 | 45 | 45 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 128 | 0 | 128 | 0 | 72 | 0 | 72 | 0 | 228 | 0 | 228 | 0 | 877 | 0 | 877 | 0 | 11,006 | 27 | 10,979 | 0 | 7,301 | 250 | 7,051 | 0 |
| | Parks | 0 | 0 | 0 | 0 | 81 | 71 | 10 | 0 | 814 | 650 | 164 | 0 | 85 | 85 | 0 | 0 | 65 | 65 | 0 | 0 | 58 | 58 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 58 | 57 | 1 | 0 | 21 | 19 | 2 | 0 | 0 | 0 | 0 | 0 | 7 | 6 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 2,645 | 1 | 252 | 2,392 | 863 | 628 | 235 | 0 | 1,165 | 766 | 398 | 0 | 1,089 | 159 | 915 | 15 | 11,394 | 279 | 11,115 | 0 | 7,359 | 308 | 7,051 | 0 |
| Municipal | Towns & Villages | 831 | 181 | 0 | 650 | 12,288 | 1,994 | 2,991 | 7,303 | 21,745 | 2,369 | 0 | 19,375 | 2,291 | 558 | 40 | 1,693 | 8,090 | 1,552 | 404 | 6,134 | 109 | 57 | 9 | 42 |
| | Other (Inst.) | 0 | 0 | 0 | 0 | 205 | 41 | 0 | 164 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 44 | 44 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 6 | 6 | 0 | 0 | 4 | 4 | 0 | 0 | 135 | 135 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Recreation | 155 | 144 | 11 | 0 | 3,127 | 60 | 2 | 3,064 | 45 | 30 | 15 | 0 | 263 | 10 | 253 | 0 | 1,420 | 104 | 1,316 | 0 | 63 | 0 | 62 | 1 |
| | Camps | 0 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subdivisions | 0 | 0 | 0 | 0 | 427 | 146 | 0 | 281 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 199 | 199 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Co-ops | 0 | 0 | 0 | 0 | 27 | 26 | 1 | 0 | 12 | 12 | 0 | 0 | 19 | 19 | 0 | 0 | 532 | 526 | 6 | 0 | 57 | 57 | 0 | 0 |
| | Sub-total | 987 | 325 | 11 | 650 | 16,086 | 2,279 | 2,994 | 10,812 | 21,814 | 2,425 | 15 | 19,375 | 2,588 | 603 | 293 | 1,693 | 10,419 | 2,559 | 1,726 | 6,134 | 229 | 115 | 71 | 43 |
| Industrial | Aggregate washing | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 7 | 178 | 126 | 15 | 36 | 21 | 6 | 0 | 15 | 624 | 132 | 364 | 127 | 0 | 0 | 0 | 0 |
| | Injection | 1,229 | 1,229 | 0 | 0 | 7,394 | 7,394 | 0 | 0 | 1,198 | 1,198 | 0 | 0 | 1,764 | 1,764 | 0 | 0 | 432 | 432 | 0 | 0 | 1,176 | 1,176 | 0 | 0 |
| | Gas /Petro | 5 | 5 | 0 | 0 | 87 | 87 | 0 | 0 | 3,903 | 2,852 | 0 | 1,051 | 12,800 | 12,000 | 0 | 800 | 58 | 58 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ind'l Processing | 2 | 2 | 0 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 11,134 | 9,925 | 0 | 1,209 | 23,957 | 1,751 | 13,568 | 8,638 | 0 | 0 | 0 | 0 |
| | Other Industrial | 1,409 | 1,406 | 2 | 0 | 1,410 | 1,388 | 14 | 9 | 4,653 | 3,396 | 2 | 1,254 | 942 | 818 | 1 | 123 | 296 | 261 | 35 | 0 | 95 | 6 | 89 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 19 | 19 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 2,645 | 2,642 | 2 | 0 | 8,901 | 8,872 | 14 | 16 | 9,931 | 7,571 | 18 | 2,342 | 26,670 | 24,522 | 1 | 2,147 | 25,385 | 2,653 | 13,968 | 8,765 | 1,271 | 1,183 | 89 | 0 |
| Water Management | Drainage | 23 | 0 | 0 | 23 | 44 | 30 | 0 | 14 | 325 | 121 | 2 | 202 | 75 | 0 | 0 | 75 | 32 | 0 | 2 | 30 | 0 | 0 | 0 | 0 |
| | Flood control | 38 | 0 | 38 | 0 | 3,034 | 0 | 3,034 | 0 | 0 | 0 | 0 | 0 | 4,342 | 3,657 | 685 | 0 | 852 | 86 | 766 | 0 | 3,084 | 3,084 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 183 | 0 | 0 | 183 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 178 | 0 | 178 | 0 | 101 | 0 | 101 | 0 | 6,357 | 321 | 6,037 | 0 | 22,573 | 0 | 22,573 | 0 | 3,253 | 0 | 3,253 | 0 | 3,715 | 0 | 3,715 | 0 |
| | Sub-total | 239 | 0 | 216 | 23 | 3,362 | 30 | 3,136 | 197 | 6,683 | 442 | 6,038 | 202 | 26,990 | 3,657 | 23,257 | 75 | 4,137 | 86 | 4,020 | 30 | 6,799 | 3,084 | 3,715 | 0 |
| TOTAL | | 6,736 | 3,096 | 575 | 3,065 | 31,322 | 13,609 | 6,689 | 11,024 | 41,088 | 12,571 | 6,598 | 21,919 | 59,190 | 30,168 | 25,091 | 3,930 | 67,793 | 13,617 | 39,247 | 14,929 | 23,704 | 7,331 | 16,325 | 47 |

Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:
1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D5b BOW RIVER BASIN

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| | | BOW RIVER 1 | | | | BOW RIVER 2 | | | | BOW RIVER 3 | | | | BOW RIVER 4 | | | | BOW RIVER 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USE | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 92 | 67 | 26 | 0 | 387 | 164 | 221 | 1 | 709 | 314 | 395 | 0 | 547 | 121 | 426 | 0 | 290 | 266 | 25 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 466 | 0 | 100 | 366 | 11 | 0 | 11 | 0 | 6,042 | 1,204 | 3 | 4,835 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 11 | 11 | 0 | 0 | 20 | 19 | 2 | 0 | 58 | 58 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 0 | 0 | 0 | 0 | 75 | 0 | 75 | 0 | 51 | 0 | 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parks | 798 | 262 | 34 | 501 | 537 | 512 | 25 | 0 | 2,369 | 1,722 | 60 | 586 | 1,439 | 1,319 | 121 | 0 | 80 | 0 | 28 | 52 |
| | Golf courses | 259 | 251 | 9 | 0 | 320 | 252 | 69 | 0 | 553 | 520 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,523 | 513 | 143 | 868 | 954 | 775 | 180 | 0 | 9,034 | 3,464 | 149 | 5,421 | 1,497 | 1,377 | 121 | 0 | 81 | 0 | 28 | 52 |
| Municipal | Towns & Villages | 1,605 | 426 | 0 | 1,179 | 6,192 | 1,674 | 966 | 3,552 | 352,131 | 69,468 | 44 | 282,618 | 204 | 48 | 79 | 76 | 410 | 81 | 0 | 328 |
| | Other (Inst.) | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 3 | 0 | 11 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 14 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 69 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 13,020 | 10,807 | 141 | 2,072 | 4,441 | 0 | 0 | 4,441 | 1,802 | 978 | 52 | 773 | 1,384 | 382 | 173 | 829 | 0 | 0 | 0 | 0 |
| | Camps | 58 | 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subdivisions | 15 | 15 | 0 | 0 | 58 | 58 | 0 | 0 | 534 | 480 | 54 | 0 | 395 | 395 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Co-ops | 16 | 16 | 0 | 0 | 4 | 4 | 0 | 0 | 17 | 17 | 1 | 0 | 11 | 6 | 5 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 14,733 | 11,341 | 141 | 3,251 | 10,695 | 1,736 | 966 | 7,993 | 354,498 | 70,945 | 151 | 283,401 | 2,075 | 912 | 257 | 906 | 410 | 81 | 0 | 328 |
| Industrial | Aggregate washing | 197 | 158 | 39 | 0 | 154 | 154 | 0 | 0 | 1,369 | 728 | 641 | 0 | 2,217 | 467 | 1,098 | 651 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ind'l Processing | 278 | 21 | 0 | 257 | 1,147 | 918 | 0 | 229 | 10,485 | 1,573 | 0 | 8,912 | 1,796 | 1 | 0 | 1,795 | 0 | 0 | 0 | 0 |
| | Other | 4,400 | 3,701 | 5 | 694 | 844 | 382 | 339 | 123 | 654 | 56 | 74 | 524 | 2,673 | 2,386 | 39 | 248 | 12,199 | 12,076 | 123 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 4,875 | 3,880 | 44 | 951 | 2,163 | 1,471 | 339 | 353 | 12,516 | 2,365 | 715 | 9,436 | 6,685 | 2,855 | 1,137 | 2,694 | 12,199 | 12,076 | 123 | 0 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 43,172 | 0 | 0 | 43,172 | 0 | 0 | 0 | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,960 | 0 | 0 | 2,960 | 0 | 0 | 0 | 0 |
| | Stablization | 0 | 0 | 0 | 0 | 17 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 33 | 33 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 43,172 | 0 | 0 | 43,172 | 22 | 0 | 17 | 5 | 4 | 0 | 4 | 0 | 2,994 | 33 | 0 | 2,960 | 0 | 0 | 0 | 0 |
| TOTAL | | 64,396 | 15,801 | 354 | 48,242 | 14,222 | 4,147 | 1,723 | 8,352 | 376,761 | 77,088 | 1,414 | 298,258 | 13,798 | 5,297 | 1,941 | 6,560 | 12,979 | 12,423 | 176 | 380 |



Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.
7. City of Calgary withdrawals and returns are reported in B3 and Elbow. Subsequent use tables assign all withdrawals to B3 and returns to B4.

# TABLE D5b BOW RIVER BASIN (Continued)

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | BOW RIVER 6 | | | | BOW RIVER 7 | | | | ELBOW RIVER | | | | HIGHWOOD RIVER | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 3,458 | 2,715 | 743 | 0 | 2,833 | 1,669 | 1,164 | 0 | 1,658 | 134 | 413 | 1,110 | 7,669 | 6,521 | 1,148 | 0 |
| Other Agric. | Feedlot | 11 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 52 | 0 | 52 | 0 | 0 | 0 | 0 | 0 | 11,973 | 0 | 33 | 11,940 | 1 | 0 | 1 | 0 |
| | Gardens | 6 | 6 | 0 | 0 | 1 | 1 | 0 | 0 | 14 | 14 | 0 | 0 | 174 | 174 | 0 | 0 |
| | Wetlands | 333 | 0 | 333 | 0 | 99 | 0 | 99 | 0 | 60 | 38 | 15 | 7 | 120 | 96 | 23 | 0 |
| | Parks | 339 | 281 | 58 | 0 | 807 | 807 | 0 | 0 | 1,793 | 721 | 60 | 1,011 | 601 | 597 | 4 | 0 |
| | Golf courses | 85 | 85 | 0 | 0 | 0 | 0 | 0 | 0 | 75 | 75 | 0 | 0 | 16 | 2 | 14 | 0 |
| | Sub-total | 825 | 382 | 443 | 0 | 907 | 808 | 99 | 0 | 13,915 | 848 | 108 | 12,959 | 912 | 870 | 42 | 0 |
| Municipal | Towns & Villages | 3,170 | 1,214 | 495 | 1,460 | 5,824 | 1,335 | 519 | 3,971 | 109,074 | 21,007 | 1,964 | 86,103 | 8,994 | 2,263 | 0 | 6,731 |
| | Other (Inst.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 22 | 0 | 0 | 6 | 6 | 0 | 0 |
| | Recreation | 389 | 201 | 188 | 0 | 0 | 0 | 0 | 0 | 1,313 | 1,153 | 113 | 47 | 70 | 36 | 35 | 0 |
| | Camps | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Subdivisions | 148 | 35 | 0 | 113 | 0 | 0 | 0 | 0 | 245 | 235 | 2 | 7 | 53 | 53 | 0 | 0 |
| | Co-ops | 502 | 479 | 23 | 0 | 72 | 47 | 25 | 0 | 345 | 345 | 0 | 0 | 8 | 8 | 0 | 0 |
| | Sub-total | 4,210 | 1,930 | 706 | 1,574 | 5,896 | 1,381 | 544 | 3,971 | 110,998 | 22,762 | 2,079 | 86,157 | 9,133 | 2,368 | 35 | 6,731 |
| Industrial | Aggregate washing | 123 | 25 | 99 | 0 | 37 | 7 | 30 | 0 | 0 | 0 | 0 | 0 | 123 | 111 | 12 | 0 |
| | Injection | 2,419 | 2,404 | 15 | 0 | 2,735 | 2,735 | 0 | 0 | 0 | 0 | 0 | 0 | 3,108 | 3,108 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 121 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 5 | 0 | 10 | 0 | 0 | 0 | 0 |
| | Other | 709 | 707 | 1 | 0 | 5,494 | 5,494 | 0 | 0 | 2,617 | 2,555 | 0 | 62 | 1,508 | 310 | 64 | 1,133 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 3,251 | 3,136 | 115 | 0 | 8,266 | 8,236 | 30 | 0 | 2,631 | 2,560 | 0 | 72 | 4,861 | 3,651 | 76 | 1,133 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 6 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 69 | 0 | 0 |
| | Stablization | 63 | 0 | 63 | 0 | 542 | 0 | 542 | 0 | 0 | 0 | 0 | 0 | 22,212 | 22,212 | 0 | 0 |
| | Sub-total | 63 | 0 | 63 | 0 | 542 | 0 | 542 | 0 | 6 | 0 | 6 | 0 | 22,281 | 22,281 | 0 | 0 |
| TOTAL | | 11,807 | 8,163 | 2,070 | 1,574 | 18,443 | 12,095 | 2,378 | 3,971 | 129,208 | 26,303 | 2,606 | 100,298 | 44,855 | 35,691 | 1,300 | 7,864 |



Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.
7. City of Calgary withdrawals and returns are reported in B3 and Elbow. Subsequent use tables assign all withdrawals to B3 and returns to B4.

# TABLE D5c OLDMAN RIVER BASIN

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | OLDMAN RIVER 1 | | | | OLDMAN RIVER 2 | | | | OLDMAN RIVER 3 | | | | OLDMAN RIVER 4 | | | | WATERTON | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 1,436 | 690 | 746 | 0 | 3,770 | 3,216 | 555 | 0 | 169 | 162 | 7 | 0 | 414 | 258 | 156 | 0 | 1,065 | 414 | 651 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 52 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 845 | 0 | 57 | 787 | 22 | 1 | 21 | 0 | 0 | 0 | 0 | 0 | 62 | 0 | 62 | 0 | 5 | 0 | 5 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 217 | 82 | 105 | 30 | 91 | 0 | 91 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 7 | 0 | 48 | 0 | 48 | 0 |
| | Parks | 921 | 125 | 575 | 222 | 958 | 941 | 17 | 0 | 0 | 0 | 0 | 0 | 80 | 73 | 7 | 0 | 0 | 0 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,983 | 207 | 738 | 1,039 | 1,072 | 942 | 130 | 0 | 0 | 0 | 0 | 0 | 201 | 125 | 76 | 0 | 53 | 0 | 53 | 0 |
| Municipal | Towns & Villages | 8,024 | 4,154 | 14 | 3,856 | 34,176 | 9,128 | 202 | 24,846 | 6 | 6 | 0 | 0 | 39 | 39 | 0 | 0 | 12 | 12 | 0 | 0 |
| | Other (Inst.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 1,843 | 73 | 1,770 | 0 | 27 | 22 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 |
| | Camps | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subdivisions | 0 | 0 | 0 | 0 | 74 | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 22 | 22 | 0 | 0 |
| | Co-ops | 743 | 277 | 467 | 0 | 459 | 417 | 42 | 0 | 7 | 7 | 0 | 0 | 53 | 49 | 4 | 0 | 116 | 107 | 10 | 0 |
| | Sub-total | 10,610 | 4,504 | 2,250 | 3,856 | 34,745 | 9,649 | 245 | 24,850 | 14 | 14 | 0 | 0 | 93 | 89 | 4 | 0 | 156 | 146 | 10 | 0 |
| Industrial | Aggregate washing | 67 | 35 | 32 | 0 | 845 | 405 | 439 | 1 | 0 | 0 | 0 | 0 | 86 | 17 | 69 | 0 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 30 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 1,214 | 1,214 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| | Other | 5,822 | 337 | 163 | 5,322 | 18,561 | 6,225 | 12,336 | 0 | 43,271 | 0 | 43,182 | 89 | 0 | 0 | 0 | 0 | 760 | 464 | 0 | 296 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 5,889 | 371 | 195 | 5,322 | 19,445 | 6,668 | 12,775 | 1 | 43,271 | 0 | 43,182 | 89 | 1,300 | 1,231 | 69 | 0 | 763 | 467 | 0 | 296 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 86 | 0 | 4 | 82 | 0 | 0 | 0 | 0 |
| | Flood control | 8,486 | 454 | 8,032 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 106 | 0 | 106 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 87 | 0 | 87 | 0 | 0 | 0 | 0 | 0 | 26 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 0 | 37 | 0 |
| | Sub-total | 8,573 | 454 | 8,119 | 0 | 0 | 0 | 0 | 0 | 26 | 26 | 0 | 0 | 192 | 0 | 110 | 82 | 37 | 0 | 37 | 0 |
| TOTAL | | 28,490 | 6,225 | 12,048 | 10,217 | 59,031 | 20,475 | 13,705 | 24,851 | 43,479 | 202 | 43,189 | 89 | 2,200 | 1,703 | 416 | 82 | 2,075 | 1,027 | 751 | 296 |



Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

## TABLE D5c OLDMAN RIVER BASIN (Continued)

### Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | BELLY | | | | ST. MARY | | | | WILLOW | | | | LITTLE BOW | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 1,940 | 1,692 | 249 | 0 | 5942 | 3093 | 2849 | 0 | 1,364 | 877 | 487 | 0 | 3,053 | 1,251 | 1,802 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 46 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 1,431 | 0 | 72 | 1,359 | 79 | 1 | 78 | 0 | 0 | 0 | 0 | 0 | 21 | 0 | 21 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 56 | 0 | 56 | 0 | 8104 | 1235 | 6869 | 0 | 42 | 0 | 42 | 0 | 7,352 | 550 | 617 | 6,185 |
| | Parks | 2 | 2 | 0 | 0 | 722 | 710 | 11 | 0 | 99 | 88 | 11 | 0 | 137 | 137 | 0 | 0 |
| | Golf courses | 370 | 333 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,859 | 336 | 164 | 1,359 | 8950 | 1992 | 6958 | 0 | 150 | 97 | 53 | 0 | 7,509 | 687 | 638 | 6,185 |
| Municipal | Towns & Villages | 778 | 142 | 0 | 636 | 13636 | 4298 | 1086 | 8252 | 1,506 | 1,506 | 0 | 0 | 1,396 | 596 | 95 | 705 |
| | Other (Inst.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 7 | 0 | 7 | 0 | 1 | 1 | 0 | 0 | 25 | 0 | 25 | 0 | 26 | 1 | 25 | 0 |
| | Camps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subdivisions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Co-ops | 27 | 27 | 0 | 0 | 412 | 330 | 33 | 49 | 2 | 2 | 0 | 0 | 624 | 550 | 74 | 0 |
| | Sub-total | 812 | 169 | 7 | 636 | 13971 | 4555 | 1115 | 8301 | 1,533 | 1,509 | 25 | 0 | 2,046 | 1,148 | 194 | 705 |
| Industrial | Aggregate washing | 0 | 0 | 0 | 0 | 155 | 51 | 105 | 0 | 0 | 0 | 0 | 0 | 174 | 19 | 0 | 155 |
| | Injection | 0 | 0 | 0 | 0 | 892 | 887 | 5 | 0 | 0 | 0 | 0 | 0 | 254 | 254 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 121 | 0 | 0 |
| | Other | 1,126 | 907 | 220 | 0 | 4496 | 1134 | 74 | 3287 | 42 | 8 | 0 | 34 | 382 | 350 | 32 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,126 | 907 | 220 | 0 | 5543 | 2072 | 184 | 3287 | 42 | 8 | 0 | 34 | 932 | 745 | 32 | 155 |
| Water Management | Drainage | 6,784 | 0 | 0 | 6,784 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,480 | 0 | 74 | 1,406 |
| | Flood control | 0 | 0 | 0 | 0 | 2584 | 0 | 2584 | 0 | 0 | 0 | 0 | 0 | 185 | 123 | 62 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8,092 | 0 | 1,992 | 6,100 | 15,168 | 9,276 | 5,892 | 0 |
| | Sub-total | 6,784 | 0 | 0 | 6,784 | 2584 | 0 | 2584 | 0 | 8,092 | 0 | 1,992 | 6,100 | 16,833 | 9,399 | 6,028 | 1,406 |
| TOTAL | | 12,522 | 3,102 | 640 | 8,780 | 37069 | 11786 | 13694 | 11589 | 11,182 | 2,492 | 2,557 | 6,133 | 30,374 | 13,230 | 8,693 | 8,451 |



Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding. St. Mary sub-basin includes St. Mary Sub (ST-M-SUB) in this table.

# TABLE D5d SOUTH SASKATCHEWAN RIVER BASIN

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | SOUTH SASKATCHEWAN 1 MAD | CONS | LOSS | Return | SOUTH SASKATCHEWAN 2 MAD | CONS | LOSS | Return |
|---|---|---|---|---|---|---|---|---|---|
| Agric/Stock | Stockwatering | 10,231 | 2,098 | 8,133 | 0 | 1,609 | 263 | 1,346 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parks | 0 | 0 | 0 | 0 | 179 | 179 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 0 | 0 | 0 | 0 | 179 | 179 | 0 | 0 |
| Municipal | Towns & Villages | 73,930 | 9,573 | 2 | 64,355 | 185 | 185 | 0 | 0 |
| | Other (Inst.) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 677 | 109 | 20 | 549 | 59 | 0 | 3 | 56 |
| | Camps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subdivisions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Co-ops | 2,398 | 1,661 | 257 | 481 | 21 | 21 | 0 | 0 |
| | Sub-total | 77,006 | 11,342 | 278 | 65,385 | 265 | 206 | 3 | 56 |
| Industrial | Aggregate washing | 67 | 14 | 53 | 0 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 73 | 73 | 0 | 0 |
| | Ind'l Processing | 25 | 25 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Other | 19,165 | 14,379 | 0 | 4,786 | 0 | 0 | 0 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 19,256 | 14,417 | 53 | 4,786 | 74 | 74 | 0 | 0 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 4,495 | 123 | 1,706 | 2,666 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 4,495 | 123 | 1,706 | 2,666 | 0 | 0 | 0 | 0 |
| TOTAL | | 110,988 | 27,981 | 10,170 | 72,837 | 2,127 | 722 | 1,349 | 56 |

Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D5e MAJOR BASINS

## Summary of Current Non-Irrigation Licenced Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | RED DEER RIVER | | | | BOW RIVER | | | | OLDMAN RIVER | | | | SOUTH SASKATCHEWAN R. | | | | TOTAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 30,181 | 15,202 | 14,976 | 4 | 17,643 | 11,970 | 4,561 | 1,111 | 19,154 | 11,653 | 7,501 | 0 | 11,840 | 2,361 | 9,479 | 0 | 78,818 | 41,185 | 36,517 | 1,115 |
| Other Agric. | Feedlot | 98 | 90 | 8 | 0 | 11 | 11 | 0 | 0 | 97 | 97 | 0 | 0 | 0 | 0 | 0 | 0 | 206 | 198 | 8 | 0 |
| | Fish | 3,195 | 350 | 438 | 2,407 | 18,545 | 1,204 | 199 | 17,141 | 2,464 | 2 | 315 | 2,147 | 0 | 0 | 0 | 0 | 24,205 | 1,556 | 953 | 21,695 |
| | Gardens | 418 | 413 | 5 | 0 | 284 | 282 | 2 | 0 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 713 | 706 | 7 | 0 |
| | Wetlands | 19,612 | 278 | 19,335 | 0 | 738 | 135 | 596 | 7 | 15,917 | 1,867 | 7,836 | 6,214 | 0 | 0 | 0 | 0 | 36,266 | 2,279 | 27,766 | 6,221 |
| | Parks | 1,104 | 930 | 174 | 0 | 8,762 | 6,221 | 391 | 2,151 | 2,920 | 2,076 | 622 | 222 | 179 | 179 | 0 | 0 | 12,965 | 9,405 | 1,186 | 2,373 |
| | Golf courses | 87 | 82 | 5 | 0 | 1,309 | 1,185 | 124 | 0 | 370 | 333 | 37 | 0 | 0 | 0 | 0 | 0 | 1,766 | 1,600 | 166 | 0 |
| | Sub-total | 24,514 | 2,143 | 19,965 | 2,407 | 29,649 | 9,037 | 1,313 | 19,299 | 21,778 | 4,386 | 8,810 | 8,583 | 179 | 179 | 0 | 0 | 76,120 | 15,744 | 30,087 | 30,289 |
| Municipal | Towns & Villages | 45,353 | 6,711 | 3,444 | 35,198 | 487,603 | 97,517 | 4,067 | 386,019 | 59,575 | 19,882 | 1,397 | 38,296 | 74,115 | 9,758 | 2 | 64,355 | 666,645 | 133,867 | 8,910 | 523,868 |
| | Other (Inst.) | 253 | 89 | 0 | 164 | 32 | 21 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 285 | 110 | 0 | 175 |
| | Schools | 151 | 151 | 0 | 0 | 110 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 261 | 261 | 0 | 0 |
| | Recreation | 5,072 | 348 | 1,659 | 3,065 | 22,420 | 13,557 | 701 | 8,162 | 1,934 | 102 | 1,828 | 4 | 736 | 109 | 23 | 605 | 30,163 | 14,116 | 4,211 | 11,836 |
| | Camps | 16 | 16 | 0 | 0 | 60 | 60 | 0 | 0 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 85 | 85 | 0 | 0 |
| | Subdivisions | 632 | 350 | 0 | 281 | 1,448 | 1,271 | 57 | 121 | 96 | 96 | 0 | 0 | 0 | 0 | 0 | 0 | 2,176 | 1,717 | 57 | 402 |
| | Co-ops | 648 | 641 | 7 | 0 | 975 | 922 | 54 | 0 | 2,444 | 1,766 | 629 | 49 | 2,419 | 1,682 | 257 | 481 | 6,487 | 5,010 | 946 | 530 |
| | Sub-total | 52,124 | 8,306 | 5,110 | 38,708 | 512,649 | 113,458 | 4,879 | 394,312 | 64,058 | 21,855 | 3,854 | 38,349 | 77,271 | 11,548 | 281 | 65,442 | 706,101 | 155,167 | 14,124 | 536,810 |
| Industrial | Aggregate Washing | 830 | 264 | 380 | 185 | 4,221 | 1,650 | 1,919 | 651 | 1,327 | 525 | 645 | 157 | 67 | 14 | 53 | 0 | 6,444 | 2,454 | 2,998 | 993 |
| | Injection | 13,192 | 13,192 | 0 | 0 | 8,262 | 8,247 | 15 | 0 | 2,389 | 2,384 | 5 | 0 | 1 | 1 | 0 | 0 | 23,844 | 23,825 | 20 | 0 |
| | Gas /Petro | 16,852 | 15,001 | 0 | 1,851 | 135 | 135 | 0 | 0 | 2 | 2 | 0 | 0 | 73 | 73 | 0 | 0 | 17,063 | 15,212 | 0 | 1,851 |
| | Ind'l Processing | 35,097 | 11,682 | 13,568 | 9,847 | 13,720 | 2,518 | 0 | 11,202 | 132 | 132 | 0 | 0 | 25 | 25 | 0 | 0 | 48,974 | 14,357 | 13,568 | 21,049 |
| | Other | 8,804 | 7,275 | 143 | 1,386 | 31,097 | 27,666 | 646 | 2,784 | 74,459 | 9,425 | 56,006 | 9,028 | 19,165 | 14,379 | 0 | 4,786 | 133,525 | 58,745 | 56,795 | 17,985 |
| | Construction | 28 | 28 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 40 | 0 | 0 |
| | Sub-total | 74,803 | 47,443 | 14,092 | 13,269 | 57,448 | 40,229 | 2,580 | 14,638 | 78,310 | 12,469 | 56,656 | 9,185 | 19,330 | 14,491 | 53 | 4,786 | 229,891 | 114,632 | 73,381 | 41,878 |
| Water Management | Drainage | 500 | 150 | 4 | 346 | 5 | 0 | 0 | 5 | 8,351 | 0 | 78 | 8,272 | 0 | 0 | 0 | 0 | 8,856 | 150 | 82 | 8,623 |
| | Flood control | 11,350 | 6,827 | 4,523 | 0 | 43,182 | 0 | 10 | 43,172 | 11,362 | 577 | 10,784 | 0 | 4,495 | 123 | 1,706 | 2,666 | 70,389 | 7,528 | 17,023 | 45,837 |
| | Remediation | 183 | 0 | 0 | 183 | 3,029 | 69 | 0 | 2,960 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,212 | 69 | 0 | 3,143 |
| | Stabilization | 36,177 | 321 | 35,856 | 0 | 22,867 | 22,245 | 622 | 0 | 23,409 | 9,302 | 8,008 | 6,100 | 0 | 0 | 0 | 0 | 82,453 | 31,868 | 44,485 | 6,100 |
| | Sub-total | 48,210 | 7,299 | 40,383 | 528 | 69,083 | 22,314 | 632 | 46,137 | 43,121 | 9,879 | 18,870 | 14,372 | 4,495 | 123 | 1,706 | 2,666 | 164,909 | 39,615 | 61,591 | 63,703 |
| TOTAL | | 229,832 | 80,392 | 94,525 | 54,916 | 686,470 | 197,008 | 13,964 | 475,498 | 226,422 | 60,242 | 95,691 | 70,488 | 113,114 | 28,702 | 11,519 | 72,893 | 1,255,839 | 366,344 | 215,699 | 673,795 |

Source: Calculated from AENV - Environmental Management System files to December 31, 1996.

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. No accounting/tracking of flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

## TABLE D6 - Summary of Expected Non-Irrigation Consumptive Use from Licences - ($dam^3$) - 1996

| BASIN | Abbr. | STOCKWATERING | OTHER AGRICULTURAL (Non-Irrigation) | MUNICIPAL | INDUSTRIAL | WATER MANAGEMENT | TOTAL |
|---|---|---|---|---|---|---|---|
| Red Deer River | RDR1 | 221 | 253 | 336 | 2,645 | 216 | 3,670 |
| | RDR2 | 2,110 | 863 | 5,273 | 8,886 | 3,166 | 20,298 |
| | RDR3 | 1,496 | 1,165 | 2,439 | 7,589 | 6,480 | 19,169 |
| | RDR4 | 1,853 | 1,074 | 895 | 24,523 | 26,915 | 55,259 |
| | RDR5 | 16,457 | 11,394 | 4,285 | 16,620 | 4,107 | 52,864 |
| | RDR6 | 8,041 | 7,359 | 186 | 1,271 | 6,799 | 23,657 |
| | Sub-total | 30,177 | 22,108 | 13,416 | 61,534 | 47,682 | 174,917 |
| Bow River | B1 | 92 | 656 | 11,482 | 3,924 | 0 | 16,154 |
| | B2 | 386 | 954 | 2,702 | 1,811 | 17 | 5,870 |
| | B3 | 709 | 3,613 | 71,097 | 3,080 | 4 | 78,502 |
| | B4 | 547 | 1,497 | 1,169 | 3,992 | 33 | 7,239 |
| | B5 | 290 | 29 | 81 | 12,199 | 0 | 12,600 |
| | B6 | 3,458 | 825 | 2,636 | 3,251 | 63 | 10,233 |
| | B7 | 2,833 | 907 | 1,925 | 8,266 | 542 | 14,473 |
| | Elbow | 547 | 956 | 24,841 | 2,560 | 6 | 28,910 |
| | Highwood | 7,669 | 912 | 2,402 | 3,727 | 22,281 | 36,991 |
| | Sub-total | 16,531 | 10,349 | 118,336 | 42,809 | 22,946 | 210,972 |
| Oldman River | O1 | 1,436 | 944 | 6,754 | 566 | 8,573 | 18,273 |
| | O2 | 3,770 | 1,072 | 9,895 | 19,443 | 0 | 34,180 |
| | O3 | 169 | 0 | 14 | 43,182 | 26 | 43,390 |
| | O4 | 414 | 201 | 93 | 1,300 | 110 | 2,118 |
| | Waterton | 1,065 | 53 | 156 | 467 | 37 | 1,779 |
| | Belly | 1,940 | 500 | 176 | 1,126 | 0 | 3,742 |
| | St. Mary | 3,051 | 2,245 | 5,671 | 2,204 | 2,584 | 15,754 |
| | St. Mary Sub | 2,892 | 6,705 | 78 | 51 | 0 | 9,726 |
| | Willow | 1,364 | 150 | 1,533 | 8 | 1,992 | 5,049 |
| | Little Bow | 3,053 | 1,325 | 1,341 | 777 | 15,427 | 21,923 |
| | Sub-total | 19,154 | 13,195 | 25,709 | 69,125 | 28,749 | 155,934 |
| South Saskatchewan R. | SS1 | 10,231 | 0 | 11,620 | 14,470 | 1,829 | 38,151 |
| | SS2 | 1,609 | 179 | 209 | 74 | 0 | 2,071 |
| | Sub-total | 11,840 | 179 | 11,829 | 14,544 | 1,829 | 40,221 |
| **TOTAL** | | **77,703** | **45,831** | **169,291** | **188,013** | **101,206** | **582,044** |

Notes:

1. Consumptive uses shown here are the sum of all withdrawals (MAD) minus return flows indicated in Table D5 and includes losses.
2. Numbers may not add exactly due to rounding.
3. City of Calgary withdrawals and returns are reported in B3 and Elbow. Subsequent use tables assign all withdrawals to B3 and returns to B4.

## Table D7 - SUMMARY OF ACTUAL MUNICIPAL WATER WITHDRAWALS AND CONSUMPTIVE USE

| NAME | SUB BASIN | Gross Diversion ($dam^3$) Average by period | | | Return Flows ($dam^3$) Average by period | | | Consumptive Use ($dam^3$) Average by period | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1990-93 | 1994-96 | 1997-99 | 1990-93 | 1994-96 | 1997-99 | 1990-93 | 1994-96 | 1997-99 |
| RED DEER RIVER | | | | | | | | | | |
| Mountain View Water Supply System | RD 2 | 2,782 | 3,006 | | | | | | | |
| City of Red Deer | RD 2 | 9,450 | 8,970 | 9,822 | | 10,127 | 11,292 | | -1,157 | -1,470 |
| Town of Innisfail | RD 2 | 930 | 971 | 943 | | 955 | 1,243 | | 16 | -300 |
| Town of Olds | RD2 | | | | | 737 | 1,236 | | | |
| Town of Eckville | RD 2 | 156 | 174 | 184 | | | | | | |
| Town of Penhold | RD 2 | 130 | 133 | 135 | to City of Red Deer | | | | | |
| Town of Sylvan Lake | RD 2 | | | 384 | | 444 | 989 | | | -605 |
| Town of Rimbey | RD 3 | | | 318 | | | | | | |
| Town of Bashaw | RD 4 | 270 | 136 | 148 | | 35 | 36 | | 101 | 112 |
| Town of Didsbury | RD 5 | 379 | 380 | 424 | | | 317 | | | 108 |
| Town of Trochu | RD 5 | 148 | | 221 | | | | | | |
| Town of Drumheller | RD 5 | | | | | 961 | 1,010 | | | |
| Village of Irricana | RD 5 | 87 | 97 | 105 | | | 115 | | | -10 |
| Village of Munson | RD 5 | | | 27 | | | | | | |
| Village of Standard | RD 5 | 71 | 84 | 94 | | 51 | 55 | | 33 | 39 |
| Village of Carbon | RD 5 | 47 | 54 | 81 | | | | | | |
| Village of Acme | RD 5 | 41 | 63 | 48 | | | | | | |
| Town of Crossfield | RD 5/B 3 | | | 301 | | | | | | |
| Henry Kroeger/Special Area #2 | RD 5/RD 6 | 677 | 692 | 788 | | | | | | |
| Municipal District of Acadia #34 | RD 6 | 29 | 32 | 34 | 0 | 0 | 0 | 29 | 32 | 34 |
| Town of Brooks | RD 6 | 2,577 | 2,627 | 3,023 | | 700 | 820 | | 1,927 | 2,204 |
| Village of Duchess | RD 6 | 140 | 125 | | | | | | | |
| RED DEER - EXTERNAL | | | | | | | | | | |
| Town of Ponoka | Battle R | 804 | 968 | 992 | | | | | | |
| Town of Lacombe | Battle R | 836 | 910 | 983 | | | | | | |
| BOW RIVER | | | | | | | | | | |
| Town of Banff | B1 | | | | | 3,314 | 2,675 | | | |
| Town of Canmore | B 1 | 1,765 | 1,873 | | | | 1,873 | | | |
| City of Calgary | B 2 | | 176,583 | 185,830 | | 150,351 | 168,110 | | 26,232 | 17,720 |
| Town of Cochrane | B 2 | 933 | 1,136 | 1,513 | currently to City of Calgary | | | | | |
| City of Airdie | B 3 | 1,562 | 1,830 | 2,195 | to City of Calgary | | | | | |
| Town of Strathmore | B 6 | 543 | | | 0 | 0 | 0 | 543 | | |
| Town of Bassano | B 6 | 331 | 292 | | 146 | 164 | | 185 | 129 | |
| Town of Gleichen (Siksika ) | B 6 | 78 | 68 | 75 | | | | | | |
| Town of Vauxhall | B 7 | 333 | 358 | 329 | | | | | | |
| Town of Black Diamond | Highwood | | 401 | 396 | | | 618 | 75 | 80 | 90 |
| Town of Okotoks | Highwood | 1,286 | 1,470 | 1,687 | 870 | 1,047 | 1,283 | 416 | 424 | 404 |
| Town of High River | Highwood | 1,478 | 1,645 | 2,353 | to Frank Lake | | | | | |
| OLDMAN RIVER | | | | | | | | | | |
| Town of Vulcan | L Bow R | 333 | 346 | 351 | 0 | 0 | 0 | 333 | 346 | 351 |
| Town of Nanton | L Bow R | 182 | 255 | 170 | 285 | 247 | 244 | -103 | 8 | -74 |
| Town of Pincher Creek (1) | O 1 | | 735 | 1,034 | | 600 | 411 | | 135 | 623 |
| Municipality of Crowsnest Pass | O 1 | 3,334 | 5,813 | 3,435 | 1,051 | 1,060 | 978 | 2,284 | 4,753 | 2,457 |
| Town of Fort Macleod | O 2 | 1,296 | 1,374 | 1,183 | | 649 | 571 | | 725 | 612 |
| City of Lethbridge | O 3 | 14,201 | 15,130 | 16,031 | | | 12,320 | | | 3,711 |
| Town of Coaldale | O 4 | 1,013 | 1,044 | 975 | | 614 | 660 | | 430 | 315 |
| Town of Picture Butte | O 4 | 354 | 384 | | 302 | 294 | | 51 | 90 | |
| Town of Taber | O 4 | | | 3,275 | | | 455 | | | 2,820 |
| Town of Magrath | St. Mary | 691 | 716 | 745 | | 356 | 356 | | 360 | 390 |
| Town of Claresholm | Willow Creek | 826 | | | | | | | | |
| Town of Granum | Willow Creek | 115 | | | | | | | | |
| SOUTH SASKATCHEWAN | | | | | | | | | | |
| Town of Bow Island | SS 1 | 334 | 351 | 384 | 0 | 0 | 0 | | | |
| City of Medicine Hat (c/w power gen.) | SS 2 | 80,244 | 81,109 | 95,940 | 64,176 | 64,066 | 78,942 | 16,068 | 17,042 | 16,999 |
| City of Medicine Hat (water to TP) | SS 2 | 16,068 | 17,042 | 16,999 | | | 8,272 | | | 8,727 |
| Town of Redcliff | SS 2 | | | 1,702 | to City of Medicine Hat | | | | | |

Consumptive use includes all uses such as effluent irrigation, water management, etc. Negatives indicate excess infiltration or storm water inflows.

Based on reports from questionnaires and AENV files. Average by period may be based on 1, 2 or 3 years data. Blank means not available.

(1) Reported Pincher Creek return flows are irrigated.

# TABLE D8a RED DEER RIVER BASIN

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | RED DEER 1 | | | | RED DEER 2 | | | | RED DEER 3 | | | | RED DEER 4 | | | | RED DEER 5 | | | | RED DEER 6 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 2,973 | 2,085 | 888 | 0 | 7,578 | 6,607 | 971 | 0 | 6,136 | 5,649 | 487 | 0 | 5,333 | 3,987 | 1,345 | 0 | 19,900 | 13,166 | 6,734 | 0 | 11,974 | 7,161 | 4,809 | 4 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 62 | 6 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 2,012 | 0 | 31 | 1,981 | 318 | 62 | 37 | 218 | 8 | 2 | 0 | 5 | 71 | 9 | 9 | 53 | 148 | 14 | 32 | 102 | 0 | 0 | 0 | 0 |
| | Gardens | 1 | 1 | 0 | 0 | 194 | 192 | 2 | 0 | 74 | 72 | 2 | 0 | 31 | 31 | 0 | 0 | 36 | 36 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 103 | 0 | 103 | 0 | 57 | 0 | 57 | 0 | 183 | 0 | 183 | 0 | 702 | 0 | 702 | 0 | 8,805 | 22 | 8,783 | 0 | 5,841 | 200 | 5,640 | 0 |
| | Parks | 0 | 0 | 0 | 0 | 65 | 57 | 8 | 0 | 651 | 520 | 131 | 0 | 68 | 68 | 0 | 0 | 52 | 52 | 0 | 0 | 46 | 46 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 47 | 46 | 1 | 0 | 17 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 6 | 5 | 1 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 2,116 | 1 | 133 | 1,981 | 690 | 366 | 106 | 218 | 932 | 609 | 318 | 5 | 871 | 108 | 711 | 53 | 9,115 | 192 | 8,822 | 102 | 5,887 | 247 | 5,640 | 0 |
| Municipal | Towns & Villages | 1,141 | 571 | | 571 | 15,672 | 4,868 | | 10,294 | 1,745 | 1,047 | | 698 | 1,781 | 1,069 | | 713 | 7,906 | 3,622 | | 4,607 | 616 | 382 | | 1,250 |
| | Schools | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 5 | 5 | 0 | 0 | 3 | 3 | 0 | 0 | 108 | 108 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Recreation | 124 | 115 | 9 | 0 | 2,501 | 48 | 2 | 2,451 | 36 | 24 | 12 | 0 | 210 | 8 | 202 | 0 | 1,136 | 83 | 1,053 | 0 | 50 | 0 | 49 | 1 |
| | Camps | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,265 | 686 | 9 | 571 | 18,183 | 4,926 | 2 | 12,745 | 1,786 | 1,076 | 12 | 698 | 2,001 | 1,087 | 202 | 713 | 9,150 | 3,813 | 1,053 | 4,607 | 667 | 383 | 49 | 1,251 |
| Industrial | Aggregate washing | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 6 | 151 | 107 | 13 | 31 | 18 | 5 | 0 | 13 | 530 | 112 | 310 | 108 | 0 | 0 | 0 | 0 |
| | Injection | 491 | 491 | 0 | 0 | 2,958 | 2,958 | 0 | 0 | 479 | 479 | 0 | 0 | 706 | 706 | 0 | 0 | 173 | 173 | 0 | 0 | 471 | 471 | 0 | 0 |
| | Gas /Petro | 3 | 3 | 0 | 0 | 56 | 56 | 0 | 0 | 2,537 | 1,854 | 0 | 683 | 8,320 | 7,800 | 0 | 520 | 38 | 38 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ind'l Processing | 2 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 7,237 | 6,451 | 0 | 786 | 15,572 | 1,138 | 8,819 | 5,614 | 0 | 0 | 0 | 0 |
| | Other | 916 | 914 | 2 | 0 | 916 | 902 | 9 | 6 | 3,024 | 2,207 | 2 | 815 | 613 | 532 | 0 | 80 | 192 | 170 | 23 | 0 | 62 | 4 | 58 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,412 | 1,410 | 2 | 0 | 3,939 | 3,918 | 9 | 12 | 6,191 | 4,647 | 15 | 1,529 | 16,899 | 15,500 | 0 | 1,399 | 16,517 | 1,643 | 9,152 | 5,722 | 532 | 475 | 58 | 0 |
| Water Management | Drainage | 19 | 0 | 0 | 19 | 35 | 24 | 0 | 11 | 260 | 97 | 1 | 162 | 60 | 0 | 0 | 60 | 26 | 0 | 1 | 24 | 0 | 0 | 0 | 0 |
| | Flood control | 31 | 0 | 31 | 0 | 2,427 | 0 | 2,427 | 0 | 0 | 0 | 0 | 0 | 3,473 | 2,926 | 548 | 0 | 682 | 69 | 613 | 0 | 2,467 | 2,467 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 146 | 0 | 0 | 146 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 142 | 0 | 142 | 0 | 81 | 0 | 81 | 0 | 5,086 | 257 | 4,829 | 0 | 18,058 | 0 | 18,058 | 0 | 2,602 | 0 | 2,602 | 0 | 2,972 | 0 | 2,972 | 0 |
| | Sub-total | 191 | 0 | 173 | 19 | 2,690 | 24 | 2,509 | 157 | 5,346 | 353 | 4,831 | 162 | 21,592 | 2,926 | 18,606 | 60 | 3,310 | 69 | 3,216 | 24 | 5,439 | 2,467 | 2,972 | 0 |
| **TOTAL** | | **7,957** | **4,183** | **1,205** | **2,571** | **33,080** | **15,841** | **3,596** | **13,132** | **20,391** | **12,334** | **5,662** | **2,394** | **46,696** | **23,607** | **20,865** | **2,224** | **57,992** | **18,882** | **28,977** | **10,455** | **24,500** | **10,732** | **13,529** | **1,255** |

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8b BOW RIVER BASIN

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| | | BOW RIVER 1 | | | | BOW RIVER 2 | | | | BOW RIVER 3 | | | | BOW RIVER 4 | | | | BOW RIVER 5 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USE | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 452 | 353 | 100 | 0 | 1,247 | 792 | 454 | 1 | 968 | 621 | 346 | 0 | 1,643 | 924 | 719 | 0 | 395 | 364 | 31 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 373 | 0 | 25 | 348 | 9 | 0 | 3 | 6 | 4,833 | 301 | 1 | 4,532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 9 | 9 | 0 | 0 | 16 | 15 | 2 | 0 | 46 | 46 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 0 | 0 | 0 | 0 | 60 | 0 | 60 | 0 | 40 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parks | 638 | 210 | 27 | 401 | 429 | 410 | 20 | 0 | 1,895 | 1,378 | 48 | 469 | 1,152 | 1,055 | 97 | 0 | 64 | 0 | 23 | 41 |
| | Golf courses | 207 | 200 | 7 | 0 | 256 | 201 | 55 | 0 | 442 | 416 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,219 | 410 | 59 | 749 | 764 | 620 | 138 | 6 | 7,227 | 2,109 | 118 | 5,001 | 1,198 | 1,101 | 97 | 0 | 64 | 0 | 23 | 41 |
| Municipal | Towns & Villages | 5,664 | 1,131 | | 4,533 | 1,847 | 1,097 | | 261 | 174,942 | 22,435 | | 295 | 1,359 | 1,090 | | 153,031 | 560 | 336 | | 78 |
| | Schools | 11 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 55 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 10,416 | 8,648 | 112 | 1,658 | 3,553 | 0 | 0 | 3,552 | 1,442 | 782 | 41 | 618 | 1,108 | 305 | 139 | 663 | 0 | 0 | 0 | 0 |
| | Camps | 46 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 16,137 | 9,834 | 112 | 6,191 | 5,400 | 1,097 | 0 | 3,813 | 176,384 | 23,217 | 41 | 913 | 2,522 | 1,451 | 139 | 153,694 | 560 | 336 | 0 | 78 |
| Industrial | Aggregate washing | 168 | 134 | 34 | 0 | 131 | 131 | 0 | 0 | 1,164 | 619 | 545 | 0 | 1,884 | 397 | 933 | 554 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ind'l Processing | 180 | 14 | 0 | 167 | 746 | 597 | 0 | 149 | 6,815 | 1,022 | 0 | 5,793 | 1,167 | 1 | 0 | 1,167 | 0 | 0 | 0 | 0 |
| | Other | 2,860 | 2,405 | 3 | 451 | 549 | 248 | 220 | 80 | 425 | 36 | 48 | 341 | 1,737 | 1,551 | 26 | 161 | 7,929 | 7,849 | 80 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 3,208 | 2,553 | 37 | 618 | 1,437 | 987 | 220 | 229 | 8,409 | 1,683 | 593 | 6,133 | 4,789 | 1,949 | 959 | 1,881 | 7,929 | 7,849 | 80 | 0 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 34,538 | 0 | 0 | 34,537 | 0 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,368 | 0 | 0 | 2,368 | 0 | 0 | 0 | 0 |
| | Stablization | 0 | 0 | 0 | 0 | 14 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 27 | 27 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 34,538 | 0 | 0 | 34,537 | 18 | 0 | 14 | 4 | 3 | 0 | 3 | 0 | 2,395 | 27 | 0 | 2,368 | 0 | 0 | 0 | 0 |
| **TOTAL** | | **55,554** | **13,151** | **309** | **42,095** | **8,865** | **3,496** | **826** | **4,054** | **192,991** | **27,630** | **1,101** | **12,047** | **12,546** | **5,451** | **1,913** | **157,944** | **8,949** | **8,550** | **134** | **119** |



Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8b BOW RIVER BASIN (Continued)

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | BOW RIVER 6 | | | | BOW RIVER 7 | | | | ELBOW RIVER | | | | HIGHWOOD RIVER | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 3,361 | 2,766 | 595 | 0 | 5,476 | 3,881 | 1,595 | 0 | 6,601 | 3,129 | 2,362 | 1,110 | 7,054 | 6,135 | 918 | 0 |
| Other Agric. | Feedlot | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 41 | 0 | 13 | 28 | 0 | 0 | 0 | 0 | 9,578 | 0 | 8 | 9,570 | 1 | 0 | 0 | 1 |
| | Gardens | 4 | 4 | 0 | 0 | 1 | 1 | 0 | 0 | 11 | 11 | 0 | 0 | 139 | 139 | 0 | 0 |
| | Wetlands | 266 | 0 | 266 | 0 | 79 | 0 | 79 | 0 | 48 | 30 | 12 | 6 | 96 | 77 | 19 | 0 |
| | Parks | 271 | 225 | 46 | 0 | 645 | 645 | 0 | 0 | 1,434 | 577 | 48 | 809 | 481 | 478 | 3 | 0 |
| | Golf courses | 68 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 60 | 0 | 0 | 13 | 2 | 11 | 0 |
| | Sub-total | 660 | 306 | 326 | 28 | 725 | 647 | 79 | 0 | 11,132 | 678 | 69 | 10,385 | 729 | 696 | 33 | 1 |
| Municipal | Towns & Villages | 4,292 | 2,865 | | 547 | 768 | 461 | | 307 | 277 | 114 | | 163 | 5,057 | 2,153 | | 2,131 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 | 17 | 0 | 0 | 5 | 5 | 0 | 0 |
| | Recreation | 311 | 161 | 150 | 0 | 0 | 0 | 0 | 0 | 1,050 | 922 | 90 | 37 | 56 | 29 | 28 | 0 |
| | Camps | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Sub-total | 4,604 | 3,027 | 150 | 547 | 768 | 461 | 0 | 307 | 1,345 | 1,054 | 90 | 200 | 5,119 | 2,188 | 28 | 2,131 |
| Industrial | Aggregate washing | 105 | 21 | 84 | 0 | 31 | 6 | 25 | 0 | 0 | 0 | 0 | 0 | 105 | 94 | 10 | 0 |
| | Injection | 968 | 962 | 6 | 0 | 1,094 | 1,094 | 0 | 0 | 0 | 0 | 0 | 0 | 1,243 | 1,243 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 79 | 79 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 3 | 0 | 6 | 0 | 0 | 0 | 0 |
| | Other | 461 | 460 | 1 | 0 | 3,571 | 3,571 | 0 | 0 | 1,701 | 1,661 | 0 | 40 | 980 | 202 | 42 | 737 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,533 | 1,442 | 91 | 0 | 4,696 | 4,671 | 25 | 0 | 1,710 | 1,664 | 0 | 47 | 2,407 | 1,618 | 52 | 737 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 | 55 | 0 | 0 |
| | Stablization | 50 | 0 | 50 | 0 | 433 | 0 | 433 | 0 | 0 | 0 | 0 | 0 | 17,770 | 17,770 | 0 | 0 |
| | Sub-total | 50 | 0 | 50 | 0 | 433 | 0 | 433 | 0 | 5 | 0 | 5 | 0 | 17,825 | 17,825 | 0 | 0 |
| **TOTAL** | | **10,208** | **7,541** | **1,212** | **575** | **12,099** | **9,660** | **2,132** | **307** | **20,793** | **6,525** | **2,526** | **11,742** | **33,134** | **28,462** | **1,031** | **2,868** |



Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8c OLDMAN RIVER BASIN

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | OLDMAN RIVER 1 | | | | OLDMAN RIVER 2 | | | | OLDMAN RIVER 3 | | | | OLDMAN RIVER 4 | | | | WATERTON | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 3,764 | 2,477 | 1,287 | 0 | 3,460 | 3,016 | 444 | 0 | 3,511 | 3,371 | 140 | 0 | 7,696 | 5,590 | 2,106 | 0 | 2,463 | 1,528 | 934 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 41 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 676 | 0 | 14 | 662 | 18 | 0 | 5 | 12 | 0 | 0 | 0 | 0 | 49 | 0 | 15 | 34 | 4 | 0 | 1 | 3 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 174 | 66 | 84 | 24 | 73 | 0 | 73 | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 6 | 0 | 38 | 0 | 38 | 0 |
| | Parks | 737 | 100 | 460 | 178 | 767 | 753 | 14 | 0 | 0 | 0 | 0 | 0 | 64 | 58 | 6 | 0 | 0 | 0 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,587 | 165 | 559 | 863 | 858 | 753 | 92 | 12 | 0 | 0 | 0 | 0 | 161 | 100 | 27 | 34 | 42 | 0 | 40 | 3 |
| Municipal | Towns & Villages | 5,716 | 4,234 | | 1,482 | 2,214 | 1,243 | | 780 | 16,833 | 4,631 | | 12,395 | 1,012 | 607 | | 1,019 | 274 | 164 | | 109 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 1,474 | 58 | 1,416 | 0 | 22 | 18 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 0 | 0 |
| | Camps | 0 | 0 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 7,190 | 4,292 | 1,416 | 1,482 | 2,243 | 1,267 | 1 | 783 | 16,833 | 4,631 | 0 | 12,395 | 1,012 | 607 | 0 | 1,019 | 278 | 168 | 0 | 109 |
| Industrial | Aggregate washing | 57 | 29 | 27 | 0 | 718 | 344 | 373 | 1 | 0 | 0 | 0 | 0 | 73 | 15 | 59 | 0 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 12 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 485 | 485 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Other | 3,784 | 219 | 106 | 3,460 | 12,065 | 4,047 | 8,018 | 0 | 28,126 | 0 | 28,068 | 58 | 0 | 0 | 0 | 0 | 494 | 301 | 0 | 192 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 3,841 | 248 | 133 | 3,460 | 12,801 | 4,408 | 8,392 | 1 | 28,126 | 0 | 28,068 | 58 | 559 | 500 | 59 | 0 | 496 | 304 | 0 | 192 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 | 0 | 3 | 66 | 0 | 0 | 0 | 0 |
| | Flood control | 6,789 | 363 | 6,426 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 | 0 | 85 | 0 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 69 | 0 | 69 | 0 | 0 | 0 | 0 | 0 | 21 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 0 | 30 | 0 |
| | Sub-total | 6,858 | 363 | 6,495 | 0 | 0 | 0 | 0 | 0 | 21 | 21 | 0 | 0 | 154 | 0 | 88 | 66 | 30 | 0 | 30 | 0 |
| **TOTAL** | | **23,240** | **7,546** | **9,890** | **5,804** | **19,361** | **9,445** | **8,929** | **796** | **48,491** | **8,023** | **28,208** | **12,453** | **9,582** | **6,797** | **2,280** | **1,119** | **3,309** | **2,000** | **1,003** | **304** |



Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8c OLDMAN RIVER BASIN (Continued)

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | BELLY | | | | ST. MARY | | | | WILLOW | | | | LITTLE BOW | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 1,751 | 1,552 | 199 | 0 | 7,034 | 4,754 | 2,279 | 0 | 2,642 | 1,947 | 695 | 0 | 11,360 | 7,144 | 4,217 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 37 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 1,145 | 0 | 18 | 1,127 | 63 | 0 | 20 | 43 | 0 | 0 | 0 | 0 | 17 | 0 | 5 | 12 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 44 | 0 | 44 | 0 | 6,483 | 988 | 5,495 | 0 | 34 | 0 | 34 | 0 | 5,881 | 440 | 493 | 4,948 |
| | Parks | 2 | 2 | 0 | 0 | 577 | 568 | 9 | 0 | 79 | 70 | 9 | 0 | 110 | 110 | 0 | 0 |
| | Golf courses | 296 | 267 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 1,487 | 269 | 92 | 1,127 | 7,160 | 1,593 | 5,524 | 43 | 120 | 78 | 42 | 0 | 6,008 | 550 | 499 | 4,959 |
| Municipal | Towns & Villages | 485 | 343 | | 142 | 6,279 | 4,438 | | 1,978 | 1,220 | 1,137 | | 84 | 2,315 | 1,556 | | 1,532 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 6 | 0 | 6 | 0 | 1 | 1 | 0 | 0 | 20 | 0 | 20 | 0 | 21 | 1 | 20 | 0 |
| | Camps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 491 | 343 | 6 | 142 | 6,280 | 4,439 | 0 | 1,978 | 1,240 | 1,137 | 20 | 84 | 2,336 | 1,557 | 20 | 1,532 |
| Industrial | Aggregate washing | 0 | 0 | 0 | 0 | 132 | 43 | 89 | 0 | 0 | 0 | 0 | 0 | 148 | 16 | 0 | 132 |
| | Injection | 0 | 0 | 0 | 0 | 357 | 355 | 2 | 0 | 0 | 0 | 0 | 0 | 102 | 102 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| | Ind'l Processing | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 79 | 79 | 0 | 0 |
| | Other | 732 | 589 | 143 | 0 | 2,922 | 737 | 48 | 2,137 | 27 | 5 | 0 | 22 | 248 | 227 | 21 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 732 | 589 | 143 | 0 | 3,411 | 1,135 | 139 | 2,137 | 27 | 5 | 0 | 22 | 577 | 424 | 21 | 132 |
| Water Management | Drainage | 5,427 | 0 | 0 | 5,427 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,184 | 0 | 59 | 1,125 |
| | Flood control | 0 | 0 | 0 | 0 | 2,067 | 0 | 2,067 | 0 | 0 | 0 | 0 | 0 | 148 | 99 | 49 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stablization | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,473 | 0 | 1,594 | 4,880 | 12,134 | 7,421 | 4,714 | 0 |
| | Sub-total | 5,427 | 0 | 0 | 5,427 | 2,067 | 0 | 2,067 | 0 | 6,473 | 0 | 1,594 | 4,880 | 13,466 | 7,519 | 4,822 | 1,125 |
| **TOTAL** | | **9,888** | **2,753** | **440** | **6,696** | **25953** | **11921** | **10009** | **4158** | **10503** | **3167** | **2351** | **4985** | **33747** | **17194** | **9578** | **7748** |



Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8d SOUTH SASKATCHEWAN RIVER BASIN

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| USE | | SOUTH SASKATCHEWAN 1 | | | | SOUTH SASKATCHEWAN 2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 14,691 | 8,185 | 6,507 | 0 | 2,800 | 1,525 | 1,275 | 0 |
| Other Agric. | Feedlot | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gardens | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wetlands | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Parks | 0 | 0 | 0 | 0 | 143 | 143 | 0 | 0 |
| | Golf courses | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 0 | 0 | 0 | 0 | 143 | 143 | 0 | 0 |
| Municipal | Towns & Villages | 89,964 | 17,801 | | 72,163 | 227 | 204 | | 23 |
| | Schools | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Recreation | 542 | 87 | 16 | 439 | 47 | 0 | 2 | 45 |
| | Camps | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 90,506 | 17,888 | 16 | 72,602 | 274 | 204 | 2 | 68 |
| Industrial | Aggregate washing | 57 | 12 | 45 | 0 | 0 | 0 | 0 | 0 |
| | Injection | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gas /Petro | 0 | 0 | 0 | 0 | 47 | 47 | 0 | 0 |
| | Ind'l Processing | 16 | 16 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Other | 12,457 | 9,346 | 0 | 3,111 | 0 | 0 | 0 | 0 |
| | Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 12,530 | 9,374 | 45 | 3,111 | 48 | 48 | 0 | 0 |
| Water Management | Drainage | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Flood control | 3,596 | 99 | 1,365 | 2,132 | 0 | 0 | 0 | 0 |
| | Remediation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Stabilization | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sub-total | 3,596 | 99 | 1,365 | 2,132 | 0 | 0 | 0 | 0 |
| TOTAL | | 121322 | 35545 | 7932 | 77845 | 3265 | 1920 | 1277 | 68 |

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

# TABLE D8e MAJOR BASINS

## Summary of Estimated Actual Non-Irrigation Withdrawals and Consumptive Use ($dam^3$) - 1996

| | | RED DEER RIVER | | | | BOW RIVER | | | | OLDMAN RIVER | | | | SOUTH SASKATCHEWAN R. | | | | TOTAL | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| USE | | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return | MAD | CONS | LOSS | Return |
| Agric/Stock | Stockwatering | 53,894 | 38,655 | 15,234 | 4 | 27,197 | 18,965 | 7,120 | 1,111 | 43,681 | 31,379 | 12,301 | 0 | 17,491 | 9,710 | 7,782 | 0 | 142,263 | 98,709 | 42,437 | 1,115 |
| Other Agric. | Feedlot | 79 | 72 | 6 | 0 | 8 | 8 | 0 | 0 | 78 | 78 | 0 | 0 | 0 | 0 | 0 | 0 | 165 | 159 | 6 | 0 |
| | Fish | 2,556 | 87 | 110 | 2,359 | 14,836 | 301 | 50 | 14,485 | 1,972 | 1 | 79 | 1,892 | 0 | 0 | 0 | 0 | 19,364 | 389 | 238 | 18,736 |
| | Gardens | 335 | 331 | 4 | 0 | 228 | 226 | 2 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 570 | 565 | 6 | 0 |
| | Wetlands | 15,690 | 222 | 15,468 | 0 | 590 | 108 | 477 | 6 | 12,733 | 1,494 | 6,268 | 4,971 | 0 | 0 | 0 | 0 | 29,013 | 1,823 | 22,213 | 4,977 |
| | Parks | 883 | 744 | 139 | 0 | 7,010 | 4,977 | 313 | 1,721 | 2,336 | 1,661 | 497 | 178 | 143 | 143 | 0 | 0 | 10,372 | 7,524 | 949 | 1,898 |
| | Golf courses | 69 | 66 | 4 | 0 | 1,047 | 948 | 99 | 0 | 296 | 267 | 30 | 0 | 0 | 0 | 0 | 0 | 1,413 | 1,280 | 133 | 0 |
| | Sub-total | 19,612 | 1,522 | 15,731 | 2,359 | 23,719 | 6,567 | 940 | 16,211 | 17,423 | 3,508 | 6,874 | 7,041 | 143 | 143 | 0 | 0 | 60,897 | 11,740 | 23,545 | 25,612 |
| Municipal | Towns & Villages | 28,861 | 11,559 | 0 | 18,133 | 194,769 | 31,683 | 0 | 161,347 | 36,348 | 18,353 | 0 | 19,521 | 90,191 | 18,005 | 0 | 72,186 | 350,166 | 79,599 | 0 | 271,186 |
| | Schools | 121 | 121 | 0 | 0 | 88 | 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 209 | 209 | 0 | 0 |
| | Recreation | 4,058 | 279 | 1,327 | 2,452 | 17,936 | 10,846 | 561 | 6,529 | 1,547 | 82 | 1,462 | 3 | 589 | 87 | 18 | 484 | 24,130 | 11,293 | 3,368 | 9,468 |
| | Camps | 13 | 13 | 0 | 0 | 48 | 48 | 0 | 0 | 7 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 68 | 68 | 0 | 0 |
| | Sub-total | 33,052 | 11,971 | 1,327 | 20,585 | 212,841 | 42,665 | 561 | 167,876 | 37,902 | 18,442 | 1,462 | 19,524 | 90,780 | 18,092 | 18 | 72,670 | 374,573 | 91,169 | 3,368 | 280,654 |
| Industrial | Aggregate Washing | 705 | 225 | 323 | 157 | 3,588 | 1,403 | 1,631 | 554 | 1,128 | 447 | 548 | 133 | 57 | 12 | 45 | 0 | 5,478 | 2,086 | 2,548 | 844 |
| | Injection | 5,277 | 5,277 | 0 | 0 | 3,305 | 3,299 | 6 | 0 | 956 | 954 | 2 | 0 | 0 | 0 | 0 | 0 | 9,538 | 9,530 | 8 | 0 |
| | Gas /Petro | 10,954 | 9,751 | 0 | 1,203 | 88 | 88 | 0 | 0 | 2 | 2 | 0 | 0 | 47 | 47 | 0 | 0 | 11,091 | 9,888 | 0 | 1,203 |
| | Ind'l Processing | 22,813 | 7,593 | 8,819 | 6,400 | 8,918 | 1,637 | 0 | 7,282 | 86 | 86 | 0 | 0 | 16 | 16 | 0 | 0 | 31,833 | 9,332 | 8,819 | 13,682 |
| | Other | 5,723 | 4,729 | 93 | 901 | 20,213 | 17,983 | 420 | 1,810 | 48,399 | 6,126 | 36,404 | 5,868 | 12,457 | 9,346 | 0 | 3,111 | 86,792 | 38,184 | 36,917 | 11,690 |
| | Construction | 18 | 18 | 0 | 0 | 8 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 26 | 0 | 0 |
| | Sub-total | 45,490 | 27,593 | 9,236 | 8,662 | 36,120 | 24,417 | 2,057 | 9,645 | 50,570 | 7,614 | 36,954 | 6,001 | 12,578 | 9,422 | 45 | 3,111 | 144,757 | 69,045 | 48,292 | 27,419 |
| Water Management | Drainage | 400 | 120 | 3 | 276 | 4 | 0 | 0 | 4 | 6,681 | 0 | 63 | 6,618 | 0 | 0 | 0 | 0 | 7,084 | 120 | 66 | 6,898 |
| | Flood control | 9,080 | 5,462 | 3,619 | 0 | 34,545 | 0 | 8 | 34,537 | 9,089 | 462 | 8,627 | 0 | 3,596 | 99 | 1,365 | 2,132 | 56,311 | 6,022 | 13,619 | 36,670 |
| | Remediation | 146 | 0 | 0 | 146 | 2,424 | 55 | 0 | 2,368 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,570 | 55 | 0 | 2,514 |
| | Stablization | 28,941 | 257 | 28,685 | 0 | 18,294 | 17,796 | 497 | 0 | 18,727 | 7,441 | 6,406 | 4,880 | 0 | 0 | 0 | 0 | 65,962 | 25,494 | 35,588 | 4,880 |
| | Sub-total | 38,568 | 5,839 | 32,307 | 423 | 55,266 | 17,852 | 505 | 36,910 | 34,497 | 7,903 | 15,096 | 11,498 | 3,596 | 99 | 1,365 | 2,132 | 131,927 | 31,692 | 49,273 | 50,962 |
| TOTAL | | 190,616 | 85,580 | 73,834 | 32,032 | 355,143 | 110,466 | 11,184 | 231,753 | 184,073 | 68,845 | 72,688 | 44,064 | 124,588 | 37,465 | 9,210 | 77,913 | 854,417 | 302,356 | 166,915 | 385,762 |

Notes:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Some accounting of major return flows from one sub-basin to another is presented here.
6. Numbers may not add exactly due to rounding.

## Table D9 Summary of Estimated Actual Non-Irrigation Water Consumption by River Basin and Major Use Categories ($dam^3$) - 1996

| BASIN | Abbr. | Stockwatering | Other (non-irrig) Agriculture | MUNICIPAL | INDUSTRIAL | Water Management | TOTAL |
|---|---|---|---|---|---|---|---|
| Red Deer R. | RDR1 | 2,973 | 134 | 695 | 1,412 | 173 | 5,387 |
| | RDR2 | 7,578 | 472 | 4,928 | 3,927 | 2,532 | 19,438 |
| | RDR3 | 6,136 | 927 | 1,088 | 4,662 | 5,184 | 17,997 |
| | RDR4 | 5,332 | 819 | 1,289 | 15,500 | 21,532 | 44,472 |
| | RDR5 | 19,900 | 9,014 | 4,866 | 10,795 | 3,285 | 47,859 |
| | RDR6 | 11,970 | 5,887 | 433 | 532 | 5,439 | 24,261 |
| | Sub-total | 53,889 | 17252 | 13299 | 36828 | 38145 | 159413 |
| | % of Total | 33.8% | 10.8% | 8.3% | 23.1% | 23.9% | |
| Bow R. | B1 | 453 | 470 | 9,946 | 2,590 | 0 | 13,459 |
| | B2 | 1,246 | 757 | 1,097 | 1,208 | 14 | 4,322 |
| | B3 | 967 | 2,227 | 23,259 | 2,276 | 3 | 28,731 |
| | B4 | 1,643 | 1,198 | 1,589 | 2,908 | 27 | 7,365 |
| | B5 | 395 | 23 | 336 | 7,929 | 0 | 8,683 |
| | B6 | 3,361 | 632 | 3,177 | 1,533 | 50 | 8,753 |
| | B7 | 5,476 | 725 | 461 | 4,696 | 433 | 11,792 |
| | Elbow | 5,491 | 747 | 1,144 | 1,664 | 5 | 9,051 |
| | Highwood | 7,053 | 729 | 2,215 | 1,670 | 17,825 | 29,492 |
| | Sub-total | 26,085 | 7,508 | 43,225 | 26,475 | 18,357 | 121,649 |
| | % of Total | 21.4% | 6.2% | 35.5% | 21.8% | 15.1% | |
| Oldman R. | O1 | 3,764 | 724 | 5,708 | 381 | 6,858 | 17,436 |
| | O2 | 3,460 | 845 | 1,268 | 12,800 | 0 | 18,373 |
| | O3 | 3,511 | 0 | 4,631 | 28,068 | 21 | 36,231 |
| | O4 | 7,696 | 127 | 607 | 559 | 88 | 9,077 |
| | Waterton | 2,462 | 40 | 168 | 304 | 30 | 3,003 |
| | Belly | 1,751 | 360 | 349 | 732 | 0 | 3,192 |
| | St. Mary | 7,033 | 7,117 | 4,439 | 1,274 | 2,067 | 21930 |
| | Willow | 2,642 | 120 | 1,157 | 5 | 1,594 | 5,518 |
| | Little Bow | 11,361 | 1,048 | 1,577 | 445 | 12,342 | 26,773 |
| | Sub-total | 43,680 | 10,382 | 19,904 | 44,568 | 23,000 | 141533 |
| | % of Total | 30.9% | 0.0% | 14.1% | 31.5% | 16.3% | |
| South Saskatchewan R. | SS1 | 14,692 | 0 | 17,904 | 9,419 | 1,463 | 43,478 |
| | SS2 | 2,800 | 143 | 206 | 48 | 0 | 3,197 |
| | Sub-total | 17,492 | 143 | 18,110 | 9,467 | 1,463 | 46,675 |
| | % of Total | 37.5% | 0.3% | 38.8% | 20.3% | 3.1% | |
| TOTAL BASIN | TOTAL | 141,146 | 35,285 | 94,538 | 117,337 | 80,965 | 469,271 |
| | % of Total | 30.1% | 7.5% | 20.1% | 25.0% | 17.3% | |

Notes:
1. Consumptive uses shown here are the sum of all withdrawals minus return flows indicated in Table D8 and includes losses.
2. Numbers may not add exactly due to rounding.

## Table D10 Summary of Percentage Increase in Estimated Actual Non-Irrigation Water Consumption from 1996 to 1999 by River Basin and Major Use Categories

| BASIN | Abbrev. | Stockwatering | Other (non-irrigation) Agriculture | MUNICIPAL | INDUSTRIAL | Water Management | TOTAL |
|---|---|---|---|---|---|---|---|
| Red Deer R. | RDR1 | 0.0% | 0.0% | 4.9% | 0.0% | 0.0% | 0.6% |
| | RDR2 | 0.0% | 0.0% | 7.0% | 0.9% | 0.0% | 2.0% |
| | RDR3 | 0.1% | 0.0% | 4.8% | 0.0% | 0.0% | 0.3% |
| | RDR4 | 0.2% | 0.0% | 3.8% | 0.0% | 0.0% | 0.1% |
| | RDR5 | 4.0% | 0.0% | 4.9% | 0.9% | 26.4% | 4.2% |
| | RDR6 | 1.2% | 2.9% | 2.1% | 0.0% | 0.0% | 1.3% |
| | **Sub-total** | **1.8%** | **1.0%** | **5.4%** | **0.4%** | **2.3%** | **1.8%** |
| Bow R. | B1 | 0.0% | 43.5% | 1.3% | 0.0% | 0.0% | 2.5% |
| | B2 | 0.0% | -1.3% | 33.8% | 0.0% | 0.0% | 8.4% |
| | B3 | 2.8% | 0.0% | -7.9% | 0.0% | 0.0% | -6.3% |
| | B4 | 2.4% | 39.0% | 3.8% | 1.3% | 778% | 11.0% |
| | B5 | 0.0% | 0.0% | 7.1% | 0.0% | 0.0% | 0.3% |
| | B6 | 0.2% | 0.0% | 11.2% | 16.9% | 0.0% | 7.1% |
| | B7 | 0.0% | 79.9% | 4.1% | 0.0% | 0.0% | 5.1% |
| | Elbow | 0.0% | 0.0% | 0.1% | 0.0% | 0.0% | 0.0% |
| | Highwood | 0.0% | 0.0% | 14.6% | 0.0% | 0.0% | 1.1% |
| | **Sub-total** | **0.3%** | **16.5%** | **-1.3%** | **1.1%** | **1.1%** | **1.0%** |
| Oldman R. | O1 | 0.0% | 0.0% | 7.8% | 0.0% | 0.0% | 2.6% |
| | O2 | 0.0% | 0.0% | 5.1% | 0.0% | 0.0% | 0.4% |
| | O3 | 0.0% | 0.0% | -3.7% | 0.0% | 0.0% | -0.5% |
| | O4 | 0.0% | 0.0% | 4.1% | 0.0% | 0.0% | 0.3% |
| | Waterton | 2.4% | 0.0% | 5.4% | 0.0% | 0.0% | 2.3% |
| | Belly | 0.3% | 4.1% | 2.9% | 0.0% | 0.0% | 0.9% |
| | St. Mary | 8.4% | 3.2% | 7.6% | 0.8% | 0.0% | 5.3% |
| | Willow | 6.8% | 0.0% | 2.2% | 0.0% | 0.0% | 3.7% |
| | Little Bow | 0.6% | 0.0% | 5.1% | 0.0% | 0.0% | 0.6% |
| | **Sub-total** | **2.1%** | **2.3%** | **4.2%** | **0.0%** | **0.0%** | **1.4%** |
| South Saskatchewan R. | SS1 | 0.9% | Infinity[3] | 1.4% | 0.0% | 0.0% | 2.5% |
| | SS2 | 1.8% | 128% | 4.4% | 13570% | 0.0% | 211% |
| | **Sub-total** | **1.0%** | **617.2%** | **1.4%** | **68.8%** | **0.0%** | **16.8%** |
| **TOTAL BASIN** | | **1.5%** | **7.2%** | **1.3%** | **5.9%** | **1.3%** | **3.0%** |

Notes:

1. Consumption used here includes losses.

2. Increases based on increase in licenses with the same actual use factors applied in 1996 and 1999. Municipal increases based upon population increases and actual reported use data. Stockwatering increases based on pro-rated license increases.

3. Large values are due to very small initial values including a value of zero in the case of SS1 Other Agriculture.

## Table D11 - Comparison of Relevant Population Projections for the Calgary Region by Different Agencies

| Agency | Geographic Unit | 1996 actual | 2001 proj | 2006 proj | 2011 proj | 2016 proj | 2021 proj | 2026 proj | 2031 proj | 2036 proj | 2041 proj | 2046 proj |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| City of Calgary | City of Calgary | 767,000 | 883,000 | 976,000 | 1,059,000 | 1,137,000 | 1,223,000 | 1,311,000 | 1,401,000 | 1,495,000 | 1,592,000 | 1,696,000 |
| | % annual change | | 2.56 | 1.88 | 1.53 | 1.70 | 1.49 | 1.39 | 1.30 | 1.29 | 1.21 | 1.25 |
| City of Calgary | Calgary CMA | 821,000 | 942,000 | 1,044,000 | 1,138,000 | 1,234,000 | 1,357,000 | 1,490,000 | 1,632,000 | 1,785,000 | 1,948,000 | 2,125,000 |
| | % annual change | | 2.61 | 1.85 | 1.61 | 2.07 | 1.88 | 1.85 | 1.81 | 1.83 | 1.78 | 1.77 |
| Statistics Canada | CD 6, low case | 906,223 | 1,052,931 | 1,130,740 | 1,190,578 | 1,238,285 | | | | | | |
| | % annual change | | 2.27 | 1.21 | 0.94 | 0.70 | | | | | | |
| Statistics Canada | CD 6, medium case | 906,223 | 1,059,996 | 1,164,374 | 1,256,312 | 1,340,738 | | | | | | |
| | % annual change | | 2.65 | 1.69 | 1.44 | 1.23 | | | | | | |
| Statistics Canada | CD 6, high case | 906,223 | 1,067,598 | 1,200,906 | 1,329,434 | 1,456,727 | | | | | | |
| | % annual change | | 3.05 | 2.20 | 1.97 | 1.77 | | | | | | |
| Alberta Treasury | CD 6, low case | n/a | 1,090,545 | 1,186,385 | 1,269,675 | 1,340,520 | | | | | | |
| | % annual change | | 2.29 | 1.56 | 1.24 | 1.00 | | | | | | |
| Alberta Treasury | CD 6, medium case | n/a | 1,093,855 | 1,190,995 | 1,274,800 | 1,345,625 | | | | | | |
| | % annual change | | 2.29 | 1.56 | 1.24 | 1.00 | | | | | | |
| Alberta Treasury | CD 6, high case | n/a | 1,096,060 | 1,195,870 | 1,282,230 | 1,355,270 | | | | | | |
| | % annual change | | 2.30 | 1.60 | 1.28 | 1.02 | | | | | | |
| Alberta Health | Calgary RHA No.4 | 833,567 | 938,154 | 1,024,910 | 1,113,259 | 1,201,597 | | | | | | |
| | % annual change | | 1.94 | 1.85 | 1.72 | 1.59 | | | | | | |
| Statistics Canada | All Alberta, medium | 2,780,639 | 3,070,500 | 3,225,500 | 3,352,900 | 3,463,600 | 3,554,900 | | | | | |
| | % annual change | | 1.54 | 0.86 | 0.73 | 0.60 | 0.46 | | | | | |

*Sources:*

City of Calgary, Corporate Economics & Regulatory Affairs, personal communication, received August 21, 2000

Statistics Canada, Demography Division, Customized Projections for 2000 to 2016, and Components of Population Growth 1999-2026 received August 29, 2000

Alberta Treasury, Statistics, Alberta Population Projections by Census Division 1999-2016, published 1999

Alberta Health, Health Surveillance, Population Projections for Alberta and its Health Regions 1999-2016, published 1998

*Note:* % annual change numbers are calculated for the year indicated in relation to the previous year - not the previous five year periods shown (e.g., percentages in the year 2001column are for the increase of 2001 over 2000).

## Table D12 Projected Population by River Basin and Sub-basin - Low, Medium and High Growth Cases

| BASIN | SUB-BASIN | 1981 Census | 1986 Census | 1991 Census | 1996 Census | 2021 Proj. Low | 2046 Proj. Low | 2021 Proj. Medium | 2046 Proj. Medium | 2021 Proj. High | 2046 Proj. High |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RED DEER RIVER | RD1 | 6,098 | 6,451 | 6,966 | 7,773 | 9,839 | 11,594 | 10,408 | 13,178 | 10,976 | 14,763 |
| | RD1A | 12,532 | 12,690 | 13,893 | 15,207 | 23,964 | 31,112 | 25,342 | 36,389 | 26,719 | 41,667 |
| | RD2 | 65,048 | 73,870 | 78,809 | 83,276 | 113,764 | 139,588 | 122,399 | 165,885 | 131,033 | 192,182 |
| | RD3 | 9,750 | 10,297 | 10,795 | 11,883 | 16,234 | 19,919 | 17,466 | 23,671 | 18,698 | 27,424 |
| | RD4 | 10,840 | 10,871 | 11,212 | 12,097 | 12,363 | 12,268 | 13,593 | 14,896 | 14,822 | 17,525 |
| | RD5 | 48,613 | 48,991 | 51,225 | 55,329 | 69,035 | 81,616 | 73,027 | 92,772 | 77,018 | 103,928 |
| | RD6 | 19,877 | 19,881 | 19,704 | 20,973 | 22,229 | 23,681 | 24,441 | 28,904 | 26,652 | 34,127 |
| | Sub-Total | **172,758** | **183,052** | **192,604** | **206,538** | **267,427** | **319,777** | **286,673** | **375,696** | **305,919** | **431,615** |
| BOW RIVER | B1[(1)] | 9,452 | 16,121 | 15,078 | 18,892 | 17,967 | 16,234 | 23,631 | 26,081 | 29,295 | 35,929 |
| | B2 | 6,621 | 7,351 | 8,858 | 11,632 | 18,330 | 23,798 | 19,384 | 27,835 | 20,438 | 31,871 |
| | B3 | 604,901 | 651,144 | 727,814 | 789,239 | 1,243,734 | 1,614,707 | 1,315,235 | 1,888,616 | 1,386,735 | 2,162,526 |
| | B4 | 3,848 | 3,080 | 5,783 | 6,594 | 10,392 | 13,491 | 10,989 | 15,780 | 11,586 | 18,068 |
| | B5 | 963 | 956 | 1,088 | 1,302 | 1,624 | 1,920 | 1,718 | 2,183 | 1,812 | 2,446 |
| | B6 | 11,754 | 12,345 | 13,090 | 15,448 | 19,275 | 22,788 | 20,389 | 25,902 | 21,504 | 29,017 |
| | B7 | 4,915 | 4,859 | 4,781 | 5,120 | 6,385 | 7,448 | 6,754 | 8,465 | 7,123 | 9,483 |
| | ELBOW | 1,629 | 1,475 | 2,208 | 2,358 | 3,716 | 4,824 | 3,929 | 5,642 | 4,143 | 6,460 |
| | HIGH | 17,548 | 19,141 | 22,834 | 27,803 | 43,813 | 56,882 | 46,332 | 66,531 | 48,851 | 76,180 |
| | Sub-Total | **661,631** | **716,472** | **801,534** | **878,387** | **1,365,236** | **1,762,090** | **1,448,362** | **2,067,036** | **1,531,487** | **2,371,981** |
| OLDMAN RIVER | BELLY | 4,139 | 4,370 | 4,324 | 4,571 | 4,845 | 5,161 | 5,327 | 6,299 | 5,809 | 7,438 |
| | LBR | 12,198 | 12,009 | 12,503 | 13,882 | 17,321 | 20,478 | 18,323 | 23,277 | 19,324 | 26,076 |
| | O1 | 13,363 | 13,092 | 12,788 | 12,491 | 13,239 | 14,104 | 14,556 | 17,215 | 15,874 | 20,326 |
| | O2 | 6,804 | 5,406 | 6,695 | 7,159 | 7,588 | 8,083 | 8,343 | 9,866 | 9,098 | 11,649 |
| | O3 | 59,267 | 64,099 | 66,341 | 68,892 | 85,907 | 100,208 | 90,873 | 113,897 | 95,839 | 127,586 |
| | O4 | 18,511 | 18,792 | 19,732 | 21,258 | 26,508 | 30,921 | 28,040 | 35,145 | 29,573 | 39,369 |
| | ST-M | 7,958 | 8,355 | 8,480 | 8,646 | 9,164 | 9,763 | 10,076 | 11,916 | 10,988 | 14,069 |
| | ST-M-SUB | 7,042 | 7,246 | 7,398 | 7,384 | 9,208 | 10,741 | 9,740 | 12,208 | 10,272 | 13,675 |
| | WAT | 1,681 | 1,783 | 1,946 | 2,120 | 2,247 | 2,394 | 2,470 | 2,922 | 2,694 | 3,450 |
| | WILL | 5,518 | 5,433 | 5,379 | 5,627 | 5,964 | 6,353 | 6,557 | 7,754 | 7,150 | 9,156 |
| | Sub-Total | **136,480** | **140,584** | **145,587** | **152,031** | **181,990** | **208,206** | **194,305** | **240,499** | **206,619** | **272,792** |
| SOUTH SASK. RIVER | SS1 | 51,535 | 52,770 | 54,276 | 58,299 | 69,424 | 76,569 | 73,439 | 87,040 | 77,454 | 97,511 |
| | SS2 | 1,677 | 1,705 | 1,759 | 1,892 | 2,253 | 2,485 | 2,384 | 2,825 | 2,514 | 3,165 |
| | Sub-Total | **53,213** | **54,475** | **56,035** | **60,192** | **71,678** | **79,054** | **75,823** | **89,865** | **79,968** | **100,676** |
| TOTAL BASIN | | **1,024,082** | **1,094,584** | **1,195,759** | **1,297,147** | **1,886,332** | **2,369,127** | **2,005,162** | **2,773,096** | **2,123,993** | **3,177,064** |

Source: based on Statistics Canada census data and calculations guided by Statistics Canada and Alberta Treasury population projections to the year 2016.

[(1)] Unusual low growth in this sub-basin is primarily due to mandated growth restrictions for the Town of Banff.

## TABLE D13 - Summary of Non-Irrigation Licence Applications in Progress as of March, 2000 ($dam^3$)

| USE | Red Deer River Basin | | | | | Bow River Basin | | | | | Oldman River Basin | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MAD | CONS | Loss | Return | No. of Lic. | MAD | CONS | Loss | Return | No. of Lic. | MAD | CONS | Loss | Return | No. of Lic. |
| Stockwatering | 11,553 | 6,616 | 4,937 | 0 | 136 | 467 | 440 | 26 | 1 | 62 | 152,230 | 149,751 | 2,478 | 0 | 80 |
| Other Agric. | 424 | 421 | 3 | 0 | 22 | 1,419 | 1,238 | 129 | 52 | 23 | 171 | 171 | 0 | 0 | 4 |
| Industrial | 3,820 | 3,777 | 41 | 2 | 40 | 441 | 389 | 52 | 0 | 23 | 192 | 192 | 0 | 0 | 9 |
| Municipal | 330 | 326 | 4 | 0 | 28 | 2,707 | 2,220 | 134 | 353 | 54 | 925 | 595 | 330 | 0 | 20 |
| Wtr. Management | 1,294 | 1,258 | 36 | 0 | 30 | 763 | 763 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 3 |
| TOTAL | 17,421 | 12,397 | 5,021 | 2 | 256 | 5,796 | 5,049 | 341 | 406 | 174 | 153,517 | 150,709 | 2,808 | 0 | 116 |

| USE | South Saskatchewan River | | | | | TOTAL BASIN | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | MAD | CONS | Loss | Return | No. of Lic. | MAD | CONS | Loss | Return | No. of Lic. |
| Stockwatering | 183,294 | 183,294 | 0 | 0 | 42 | 347,543 | 340,100 | 7,441 | 1 | 320 |
| Other Agric. | 0 | 0 | 0 | 0 | 0 | 2,013 | 1,829 | 132 | 52 | 49 |
| Industrial | 31,980 | 31,980 | 0 | 0 | 3 | 36,433 | 36,338 | 93 | 2 | 75 |
| Municipal | 110,828 | 110,828 | 0 | 0 | 6 | 114,790 | 113,969 | 468 | 353 | 108 |
| Wtr. Management | 0 | 0 | 0 | 0 | 0 | 2,057 | 2,021 | 36 | 0 | 45 |
| TOTAL | 326,102 | 326,102 | 0 | 0 | 51 | 502,837 | 494,257 | 8,171 | 408 | 597 |

Note:

1. MAD indicates Mean Annual Diversion (i.e. withdrawal).
2. CONS indicates expected consumptive use.
3. LOSS indicates expected losses due to evaporation, infiltration, etc.
4. Return indicates expected return flow.
5. Numbers may not add exactly due to rounding.
6. Based on AENV application files in progress as of March 2000.
7. Excludes non-consumptive hydropower applications currently in progress.

## TABLE D14a Macro Factors Affecting Population Growth in the Study Area

| Factor | Effects throughout the study area | Effects in the major cities | Effects in smaller and less populous municipalities |
|---|---|---|---|
| Growth in electronic communications | Significantly **positive**, especially over the long term; impacts of e-commerce not yet clear for many types of business | Significantly **positive**, an increasing proportion of office workers will work from home | **Positive**, but effects will be more apparent after arrival of high-speed fibre-optic cable |
| Changing lifestyle preferences in favour of quality of life | Significantly **positive** as quality of life issues compete with income as key in selecting residence and work locations | Significantly **positive**, especially for select neighbourhoods and communities within commuting distance | Could be **positive** if essential services are available |
| Strengthened government policies favouring regional development, social development and infrastructure | **Positive** especially when these policies lead to more efficient distribution of government assistance (e.g., health services) and infrastructure | May be **positive**; typically this can be a factor which draws migrants from other provinces and from abroad | Rural populations will be impacted **positively** or **negatively** depending on whether government decides to support highly decentralized services |
| Ongoing uncertainty in pricing and supply of energy, incl. oil and natural gas | Periodic weakness in energy markets will impact the study area **negatively** until further progress is made with economic diversification and affordable alternative fuels | High energy prices will have a **negative** effect on non-energy producing businesses and poorer segments of the urban population | High energy prices will have a net **negative** effect on rural populations whose livelihood is not tied to the petroleum sector |
| More restrictive government policies with respect to implementation of the Kyoto Protocol | May be **negative** for industries with significant greenhouse gas emissions | May be **negative** for larger cities with significant greenhouse gas emissions | Negligible, except for specific industries such as oil and gas and thermal power generation |
| Continued attraction of migrants from other provinces and countries | Slightly **positive** with small numbers of migrants moving to small cities and towns in the region | **Positive**, adults of working age and their families are attracted from other provinces and abroad | Negligible, except for willingness of some professionals who are migrants to live in remote communities |
| Further uncertainty in Canada's process of nation-building | **Uncertain** as to outcomes | **Uncertain** but could be strongly positive for Calgary as a major financial/manufacturing centre in a Canada without Quebec | **Uncertain** as to outcomes |

Note: Positive and negative are used here to refer to the expected relationship between study area population and the factor in question. They do not reflect a value judgment with respect to the desirability or otherwise of the expected trend.

## Table D14b City-Focused Micro Factors Affecting Population Growth in the Study Area

| Factor | Effects throughout the study area | Effects in the major cities | Effects in smaller and less populous municipalities |
|---|---|---|---|
| Arterial highway expansion | **Positive** in that it facilitates growth of functional regions, serving to counter the tendency for cities to grow ever larger | **Positive** in assisting major cities to reduce traffic congestion; downside is commuters do not contribute to municipal tax base | Not critical in most situations |
| Worsening traffic congestion (and increasing commute times) | **Negative** for the region; this may be caused by transportation networks falling behind needs | **Negative** for the city; this may be caused by transportation networks falling behind needs | Not an issue |
| Initiation of suburban train service | **Positive** in assisting major cities to reduce traffic congestion; can facilitate growth of communities in commuting range | If planned appropriately, effect could be **positive** in assisting major cities to reduce traffic congestion | Not an issue |
| Rise of significant industrial nodes, e.g., in agri-food processing, high tech | Usually **positive** if harmful infrastructure and environmental impacts can be mitigated | **Positive** if the city can court a critical mass of expertise & companies, and require effective mitigation of impacts | Not an issue |
| Continued draw of young people to the major cities | Slightly **negative** as some young people leave the region, to pursue their quest for higher education, work and travel | **Positive**, young people are attracted from rural areas, especially for higher education, work and the "bright lights" | **Negative**, young people leave for higher education and the "bright lights" and usually do not return |
| Increasing crime | Not normally considered on a regional basis | **Negative** for the city; this may be caused by poverty, lack of community cohesion, lack of confidence in the justice system, etc. | Normally not applicable |
| Growing sports and recreation infrastructure | **Positive** as more opportunities are offered for golf, equestrian, watersports,campgrounds, backcountry, cabin/artificial lake developments, retreat and entertainment facilities | **Positive** as the public enjoys greater access to swimming pools, sports arenas, bike paths, theatres, concert halls, art galleries etc. | Not an issue unless the rural community is successful in hosting a new sports or recreation facility |

Note: Positive and negative are used here to refer to the expected relationship between study area population and the factor in question. They do not reflect a value judgment with respect to the desirability or otherwise of the expected trend.

## Table D14c Rural-Focused Micro Factors Affecting Population Growth in the Study Area

| Factor | Effects throughout the study area | Effects in the major cities | Effects in smaller and less populous municipalities |
|---|---|---|---|
| Further secondary highway expansion and refurbishment | **Positive** as it facilitates growth of functional regions, serving to counter the tendency for cities to grow ever larger | Not critical in most situations | At current stage of highway network, expansion can often impact small rural communities **negatively** by reducing driving times to larger service centres |
| Progressive and creative development policies of individual municipalities | Can be **positive** if based on an understanding of regional cooperation/ complementarity rather than outright competitiveness | Can be **positive** if based on sound premises and community support | May be **positive** in very special circumstances |
| Fostering a very particular public image | Not normally considered on a regional basis | Negligible, only relevant with respect to individual neighbourhoods | **Positive**, some communities can build a very particular public image to attract population |
| Further tourism and recreation development | **Positive**, especially if the area is not saturated with such facilities | Significantly **positive**, given sound planning practices | Can be **positive** if tourism /recreation can be generated by the community itself |
| Cumulative losses of infrastructure and businesses in small population centres | Slight to moderately **negative**, however the population in these centres is small | Can be a **negative** factor in older/depressed city neighbourhoods and industrial areas | Significantly **negative**, as losses especially in retail and services become cumulative, often precipitating depopulation |
| Growth in intensive livestock operations | Slight to moderately **negative** depending on the way environmental issues are handled | Normally not applicable | **Positive** in terms of jobs and tax base, but can lead to conflicts over environmental impacts (odour, groundwater) |
| Continuing trend toward fewer and larger farming operations | Slightly **negative**, as population continues to move off farms and into towns and cities. | Not an issue | Mixed effects, strongly **negative** for the "family farm," up to a point positive in terms of farm output |
| Growth of irrigated agriculture | Negligible, except for potential conflicts in the long term between different categories of water users | Not an issue | Strongly **positive**, with linkages to value-added processing and spinoffs to equipment suppliers |

Note: Positive and negative are used here to refer to the expected relationship between study area population and the factor in question. They do not reflect a value judgment with respect to the desirability or otherwise of the expected trend.

## Table D15 Summary of Year 2021 Projected Non-Irrigation Water Withdrawal - Low, Medium and High Growth Cases ($dam^3$)

| BASIN | Sub-basin | Stockwatering | | | Other (non-irrigation) Agriculture | | | MUNICIPAL | | | INDUSTRIAL | | | Water Management | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High |
| Red Deer River | RDR1 | 3,716 | 3,865 | 4,014 | 2,544 | 2,833 | 3,137 | 1,423 | 1,590 | 1,786 | 2,471 | 2,824 | 3,177 | 230 | 256 | 284 | 10,384 | 11,368 | 12,397 |
| | RDR2 | 7,957 | 8,336 | 8,715 | 917 | 1,035 | 1,161 | 21,889 | 24,815 | 28,806 | 8,862 | 9,847 | 10,832 | 3,573 | 4,035 | 4,524 | 43,199 | 48,069 | 54,038 |
| | RDR3 | 6,443 | 6,750 | 7,056 | 1,209 | 1,370 | 1,540 | 2,176 | 5,106 | 5,949 | 13,930 | 15,478 | 17,026 | 6,938 | 7,857 | 8,832 | 30,696 | 36,561 | 40,403 |
| | RDR4 | 5,600 | 5,866 | 6,133 | 846 | 979 | 1,121 | 1,841 | 2,136 | 2,456 | 38,022 | 42,247 | 46,471 | 20,964 | 24,262 | 27,778 | 67,273 | 75,490 | 83,960 |
| | RDR5 | 27,860 | 29,850 | 31,840 | 10,805 | 12,031 | 13,323 | 10,091 | 11,284 | 12,711 | 28,905 | 33,034 | 37,163 | 3,923 | 4,368 | 4,837 | 81,583 | 90,567 | 99,875 |
| | RDR6 | 16,764 | 17,961 | 19,158 | 5,928 | 6,860 | 7,855 | 635 | 735 | 844 | 932 | 1,065 | 1,198 | 5,477 | 6,338 | 7,258 | 29,735 | 32,959 | 36,313 |
| | Sub-total | 68,339 | 72,628 | 76,916 | 22,249 | 25,109 | 28,137 | 38,056 | 45,667 | 52,552 | 93,122 | 104,494 | 115,866 | 41,105 | 47,117 | 53,513 | 262,871 | 295,014 | 326,985 |
| | % of Total | | 24.6% | | | 8.5% | | | 15.5% | | | 35.4% | | | 16.0% | | | | |
| Bow River | B1 | 452 | 475 | 497 | 1,101 | 1,525 | 1,984 | 13,576 | 18,865 | 25,024 | 3,208 | 3,289 | 3,369 | 31,205 | 43,202 | 56,235 | 49,542 | 67,354 | 87,109 |
| | B2 | 1,247 | 1,309 | 1,372 | 1,143 | 1,272 | 1,409 | 7,565 | 8,450 | 9,489 | 2,012 | 2,156 | 2,299 | 27 | 30 | 33 | 11,994 | 13,217 | 14,601 |
| | B3 | 968 | 1,016 | 1,065 | 10,820 | 12,044 | 13,334 | 236,400 | 264,685 | 309,885 | 21,023 | 25,228 | 29,433 | 4 | 5 | 5 | 269,215 | 302,978 | 353,722 |
| | B4 | 1,643 | 1,725 | 1,807 | 1,793 | 1,996 | 2,210 | 3,341 | 3,735 | 4,199 | 11,972 | 14,367 | 16,761 | 3,585 | 3,991 | 4,418 | 22,335 | 25,814 | 29,396 |
| | B5 | 494 | 514 | 533 | 76 | 85 | 94 | 605 | 676 | 775 | 11,101 | 11,894 | 12,687 | 0 | 0 | 0 | 12,276 | 13,169 | 14,089 |
| | B6 | 4,201 | 4,369 | 4,537 | 783 | 871 | 965 | 4,511 | 5,173 | 6,050 | 2,683 | 3,066 | 3,449 | 60 | 66 | 74 | 12,237 | 13,546 | 15,075 |
| | B7 | 6,845 | 7,119 | 7,393 | 859 | 957 | 1,060 | 862 | 962 | 1,069 | 8,219 | 9,393 | 10,567 | 513 | 571 | 633 | 17,298 | 19,002 | 20,720 |
| | Elbow | 6,601 | 6,931 | 7,261 | 16,665 | 18,551 | 20,537 | 1,907 | 2,129 | 2,363 | 1,710 | 1,753 | 1,796 | 7 | 8 | 9 | 26,891 | 29,372 | 31,967 |
| | Highwood | 7,054 | 7,407 | 7,759 | 1,092 | 1,216 | 1,346 | 6,963 | 7,786 | 8,963 | 4,212 | 4,814 | 5,416 | 26,685 | 29,704 | 32,885 | 46,006 | 50,927 | 56,369 |
| | Sub-total | 29,505 | 30,865 | 32,225 | 34,333 | 38,517 | 42,939 | 275,730 | 312,461 | 367,817 | 66,141 | 75,958 | 85,776 | 62,086 | 77,578 | 94,292 | 467,795 | 535,379 | 623,049 |
| | % of Total | | 5.8% | | | 7.2% | | | 58.4% | | | 14.2% | | | 14.5% | | | | |
| Oldman River | O1 | 4,705 | 4,893 | 5,081 | 1,598 | 1,849 | 2,117 | 6,572 | 7,636 | 9,115 | 3,841 | 3,937 | 4,033 | 6,906 | 7,992 | 9,151 | 23,621 | 26,308 | 29,498 |
| | O2 | 4,325 | 4,498 | 4,671 | 863 | 999 | 1,144 | 2,112 | 2,429 | 2,883 | 22,401 | 25,601 | 28,801 | 0 | 0 | 0 | 29,702 | 33,528 | 37,500 |
| | O3 | 4,389 | 4,564 | 4,740 | 0 | 0 | 0 | 17,880 | 20,023 | 23,408 | 49,220 | 56,252 | 63,283 | 25 | 27 | 30 | 71,514 | 80,866 | 91,461 |
| | O4 | 9,620 | 10,005 | 10,390 | 191 | 212 | 235 | 1,135 | 1,267 | 1,407 | 978 | 1,118 | 1,258 | 182 | 203 | 225 | 12,106 | 12,805 | 13,514 |
| | Waterton | 3,079 | 3,202 | 3,325 | 43 | 49 | 57 | 265 | 308 | 356 | 868 | 992 | 1,116 | 30 | 34 | 39 | 4,284 | 4,586 | 4,893 |
| | Belly | 2,189 | 2,276 | 2,364 | 1,497 | 1,733 | 1,984 | 468 | 542 | 622 | 1,025 | 1,098 | 1,171 | 5,465 | 6,325 | 7,242 | 10,644 | 11,974 | 13,383 |
| | St. Mary | 8,793 | 9,144 | 9,496 | 7,795 | 8,851 | 9,970 | 6,469 | 7,317 | 8,468 | 4,775 | 5,117 | 5,458 | 2,251 | 2,555 | 2,879 | 30,083 | 32,984 | 36,271 |
| | Willow | 3,303 | 3,435 | 3,567 | 121 | 140 | 161 | 1,137 | 1,322 | 1,575 | 48 | 55 | 61 | 6,518 | 7,543 | 8,637 | 11,127 | 12,495 | 14,001 |
| | Little Bow | 14,200 | 14,768 | 15,336 | 7,121 | 7,929 | 8,781 | 2,570 | 2,869 | 3,228 | 1,010 | 1,154 | 1,299 | 15,962 | 17,774 | 19,683 | 40,864 | 44,494 | 48,326 |
| | Sub-total | 54,601 | 56,785 | 58,969 | 19,229 | 21,763 | 24,449 | 38,610 | 43,714 | 51,063 | 84,166 | 95,323 | 106,480 | 37,338 | 42,455 | 47,887 | 233,945 | 260,040 | 288,848 |
| | % of Total | | 21.8% | | | 8.4% | | | 16.8% | | | 36.7% | | | 16.3% | | | | |
| South Sask. River | SS1 | 18,364 | 19,098 | 19,833 | 0 | 0 | 0 | 91,705 | 102,701 | 120,212 | 21,927 | 25,059 | 28,192 | 4,068 | 4,530 | 5,016 | 136,064 | 151,388 | 173,253 |
| | SS2 | 3,500 | 3,640 | 3,780 | 162 | 180 | 200 | 714 | 797 | 885 | 84 | 96 | 108 | 0 | 0 | 0 | 4,460 | 4,713 | 4,972 |
| | Sub-total | 21,864 | 22,738 | 23,613 | 162 | 180 | 200 | 92,419 | 103,498 | 121,097 | 22,011 | 25,155 | 28,300 | 4,068 | 4,530 | 5,016 | 140,523 | 156,101 | 178,226 |
| | % of Total | | 14.6% | | | 0.1% | | | 66.3% | | | 16.1% | | | 2.9% | | | | |
| TOTAL BASIN | TOTAL | 174,309 | 183,016 | 191,723 | 75,973 | 85,569 | 95,724 | 444,814 | 505,339 | 592,530 | 265,439 | 300,931 | 336,422 | 144,598 | 171,680 | 200,709 | 1,105,133 | 1,246,535 | 1,417,108 |
| | % of Total | | 14.7% | | | 6.9% | | | 40.5% | | | 24.1% | | | 13.8% | | | | |

Notes: 1. Refer to text for assumed growth scenarios

## Table D16 Summary of Year 2021 Projected Non-Irrigation Water Consumption - Low, Medium and High Growth Cases ($dam^3$)

| BASIN | Sub-basin | Stockwatering | | | Other (non-irrig) Agriculture | | | MUNICIPAL | | | INDUSTRIAL | | | Water Management | | | TOTAL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High |
| Red Deer River | RDR1 | 3,716 | 3,865 | 4,014 | 162 | 180 | 199 | 782 | 874 | 981 | 2,471 | 2,824 | 3,177 | 208 | 231 | 256 | 7,338 | 7,974 | 8,626 |
| | RDR2 | 7,957 | 8,336 | 8,715 | 627 | 708 | 794 | 6,006 | 6,806 | 7,918 | 8,836 | 9,818 | 10,800 | 3,365 | 3,799 | 4,259 | 26,790 | 29,467 | 32,485 |
| | RDR3 | 6,443 | 6,750 | 7,056 | 1,203 | 1,362 | 1,531 | 1,326 | 4,140 | 4,850 | 10,489 | 11,655 | 12,820 | 6,728 | 7,619 | 8,565 | 26,188 | 31,526 | 34,822 |
| | RDR4 | 5,599 | 5,865 | 6,132 | 795 | 920 | 1,053 | 1,186 | 1,376 | 1,582 | 34,875 | 38,750 | 42,625 | 20,906 | 24,194 | 27,701 | 63,360 | 71,105 | 79,093 |
| | RDR5 | 27,860 | 29,850 | 31,840 | 10,684 | 11,897 | 13,175 | 5,394 | 6,031 | 6,762 | 18,891 | 21,589 | 24,288 | 3,894 | 4,336 | 4,802 | 66,723 | 73,703 | 80,867 |
| | RDR6 | 16,758 | 17,955 | 19,152 | 5,928 | 6,860 | 7,855 | 412 | 477 | 547 | 932 | 1,065 | 1,198 | 5,477 | 6,338 | 7,258 | 29,506 | 32,695 | 36,009 |
| | Sub-total | 68,333 | 72,621 | 76,908 | 19,398 | 21,927 | 24,607 | 15,105 | 19,704 | 22,639 | 76,494 | 85,701 | 94,908 | 40,576 | 46,518 | 52,841 | 219,906 | 246,471 | 271,903 |
| | % of Total | | 29.5% | | | 8.9% | | | 8.0% | | | 34.8% | | | 18.9% | | | | |
| Bow River | B1 | 453 | 476 | 498 | 424 | 588 | 765 | 8,479 | 11,774 | 15,424 | 2,590 | 2,655 | 2,720 | 0 | 0 | 0 | 11,947 | 15,493 | 19,407 |
| | B2 | 1,246 | 1,308 | 1,371 | 1,134 | 1,262 | 1,397 | 1,500 | 1,677 | 1,927 | 1,691 | 1,812 | 1,932 | 21 | 23 | 25 | 5,591 | 6,082 | 6,653 |
| | B3 | 967 | 1,015 | 1,064 | 3,334 | 3,711 | 4,108 | 31,232 | 34,964 | 40,847 | 5,690 | 6,828 | 7,966 | 4 | 5 | 5 | 41,227 | 46,523 | 53,990 |
| | B4 | 1,643 | 1,725 | 1,807 | 1,793 | 1,996 | 2,210 | 2,018 | 2,258 | 2,560 | 7,269 | 8,723 | 10,177 | 40 | 44 | 49 | 12,764 | 14,747 | 16,803 |
| | B5 | 494 | 514 | 533 | 27 | 30 | 34 | 363 | 406 | 465 | 11,101 | 11,894 | 12,687 | 0 | 0 | 0 | 11,985 | 12,844 | 13,719 |
| | B6 | 4,201 | 4,369 | 4,537 | 749 | 834 | 923 | 3,102 | 3,559 | 4,171 | 2,683 | 3,066 | 3,449 | 60 | 66 | 74 | 10,794 | 11,894 | 13,154 |
| | B7 | 6,845 | 7,119 | 7,393 | 859 | 957 | 1,060 | 517 | 577 | 641 | 8,219 | 9,393 | 10,567 | 513 | 571 | 633 | 16,953 | 18,617 | 20,293 |
| | Elbow | 5,491 | 5,766 | 6,040 | 1,118 | 1,245 | 1,378 | 1,619 | 1,807 | 2,006 | 1,664 | 1,705 | 1,747 | 7 | 8 | 9 | 9,900 | 10,531 | 11,180 |
| | Highwood | 7,053 | 7,406 | 7,758 | 1,091 | 1,214 | 1,344 | 3,005 | 3,360 | 3,873 | 2,923 | 3,341 | 3,758 | 26,685 | 29,704 | 32,885 | 40,757 | 45,025 | 49,619 |
| | Sub-total | 28,393 | 29,697 | 31,002 | 10,530 | 11,837 | 13,219 | 51,835 | 60,381 | 71,912 | 43,830 | 49,416 | 55,003 | 27,330 | 30,423 | 33,681 | 161,918 | 181,755 | 204,817 |
| | % of Total | | 16.3% | | | 6.5% | | | 33.2% | | | 27.2% | | | 16.7% | | | | |
| Oldman River | O1 | 4,705 | 4,893 | 5,081 | 729 | 843 | 966 | 5,229 | 6,075 | 7,235 | 381 | 391 | 400 | 6,906 | 7,992 | 9,151 | 17,950 | 20,195 | 22,834 |
| | O2 | 4,325 | 4,498 | 4,671 | 851 | 985 | 1,128 | 1,196 | 1,379 | 1,634 | 22,399 | 25,599 | 28,799 | 0 | 0 | 0 | 28,771 | 32,461 | 36,232 |
| | O3 | 4,389 | 4,564 | 4,740 | 0 | 0 | 0 | 8,803 | 9,858 | 11,525 | 49,119 | 56,136 | 63,153 | 25 | 27 | 30 | 62,336 | 70,586 | 79,448 |
| | O4 | 9,620 | 10,005 | 10,390 | 150 | 167 | 185 | 681 | 760 | 844 | 978 | 1,118 | 1,258 | 105 | 116 | 129 | 11,534 | 12,167 | 12,806 |
| | Waterton | 3,078 | 3,201 | 3,324 | 40 | 46 | 53 | 160 | 186 | 215 | 531 | 607 | 683 | 30 | 34 | 39 | 3,839 | 4,075 | 4,315 |
| | Belly | 2,189 | 2,276 | 2,364 | 363 | 420 | 481 | 333 | 386 | 443 | 1,025 | 1,098 | 1,171 | 0 | 0 | 0 | 3,909 | 4,180 | 4,458 |
| | St. Mary | 8,791 | 9,143 | 9,495 | 7,749 | 8,798 | 9,911 | 4,626 | 5,222 | 6,053 | 1,784 | 1,911 | 2,038 | 2,251 | 2,555 | 2,879 | 25,201 | 27,629 | 30,375 |
| | Willow | 3,303 | 3,435 | 3,567 | 121 | 140 | 161 | 1,057 | 1,229 | 1,468 | 10 | 11 | 12 | 1,605 | 1,857 | 2,126 | 6,095 | 6,672 | 7,334 |
| | Little Bow | 14,201 | 14,769 | 15,337 | 1,243 | 1,384 | 1,532 | 1,732 | 1,933 | 2,177 | 779 | 890 | 1,001 | 14,629 | 16,289 | 18,039 | 32,583 | 35,265 | 38,086 |
| | Sub-total | 54,600 | 56,784 | 58,968 | 11,246 | 12,784 | 14,417 | 23,818 | 27,028 | 31,594 | 77,006 | 87,761 | 98,517 | 25,549 | 28,872 | 32,394 | 192,219 | 213,230 | 235,888 |
| | % of Total | | 26.6% | | | 6.0% | | | 12.7% | | | 41.2% | | | 13.5% | | | | |
| South Sask. River | SS1 | 18,365 | 19,100 | 19,834 | 0 | 0 | 0 | 18,190 | 20,367 | 23,786 | 16,483 | 18,838 | 21,192 | 1,655 | 1,843 | 2,041 | 54,693 | 60,148 | 66,854 |
| | SS2 | 3,500 | 3,640 | 3,780 | 162 | 180 | 200 | 221 | 247 | 274 | 84 | 96 | 108 | 0 | 0 | 0 | 3,967 | 4,163 | 4,362 |
| | Sub-total | 21,865 | 22,740 | 23,614 | 162 | 180 | 200 | 18,411 | 20,614 | 24,060 | 16,567 | 18,934 | 21,300 | 1,655 | 1,843 | 2,041 | 58,660 | 64,311 | 71,215 |
| | % of Total | | 35.4% | | | 0.3% | | | 32.1% | | | 29.4% | | | 2.9% | | | | |
| TOTAL BASIN | TOTAL | 173,191 | 181,841 | 190,492 | 41,335 | 46,728 | 52,443 | 109,169 | 127,728 | 150,205 | 213,896 | 241,812 | 269,728 | 95,111 | 107,657 | 120,957 | 632,703 | 705,767 | 783,825 |
| | % of Total | | 25.8% | | | 6.6% | | | 18.1% | | | 34.3% | | | 15.3% | | | | |

Notes:
1. Refer to text for assumed growth scenarios
2. Consumption used here includes losses.

## TABLE D19

## SUMMARY OF PER CAPITA WATER USE - 1996 ESTIMATED ACTUAL & 2021 AND 2046 MEDIUM CASE ($m^3$/person/year)

| BASIN | Stockwatering | | Other (non-irrig) Agriculture | | MUNICIPAL | | INDUSTRIAL | | Water Management | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MAD | CONS | MAD | CONS | MAD | CONS | MAD | CONS | MAD | CONS | MAD | CONS |
| | **YEAR 1996** | | | | | | | | | | | |
| RED DEER | 261 | 261 | 95 | 84 | 160 | 64 | 220 | 178 | 187 | 185 | 923 | 772 |
| BOW | 31 | 30 | 27 | 9 | 242 | 49 | 41 | 30 | 63 | 21 | 404 | 138 |
| OLDMAN | 287 | 287 | 115 | 68 | 249 | 131 | 333 | 293 | 227 | 151 | 1211 | 931 |
| SOUTH SASKATCHEWAN | 291 | 291 | 2 | 2 | 1508 | 301 | 209 | 157 | 60 | 24 | 2070 | 775 |
| TOTAL | 110 | 109 | 47 | 27 | 289 | 73 | 112 | 90 | 102 | 62 | 659 | 362 |
| | **YEAR 2021** | | | | | | | | | | | |
| RED DEER | 253 | 253 | 88 | 76 | 159 | 69 | 365 | 299 | 164 | 162 | 1029 | 860 |
| BOW | 21 | 21 | 27 | 26 | 216 | 42 | 52 | 34 | 54 | 21 | 370 | 125 |
| OLDMAN | 292 | 292 | 112 | 66 | 225 | 139 | 491 | 452 | 218 | 149 | 1338 | 1097 |
| SOUTH SASKATCHEWAN | 300 | 300 | 2 | 2 | 1365 | 272 | 332 | 250 | 60 | 24 | 2059 | 848 |
| TOTAL | 91 | 91 | 43 | 23 | 252 | 64 | 150 | 121 | 86 | 54 | 622 | 352 |
| | **YEAR 2046** | | | | | | | | | | | |
| RED DEER | 218 | 218 | 83 | 73 | 155 | 66 | 435 | 358 | 149 | 147 | 1041 | 862 |
| BOW | 15 | 15 | 26 | 8 | 202 | 38 | 56 | 35 | 47 | 21 | 347 | 117 |
| OLDMAN | 254 | 254 | 111 | 65 | 213 | 132 | 582 | 545 | 216 | 148 | 1377 | 1143 |
| SOUTH SASKATCHEWAN | 272 | 273 | 2 | 2 | 1291 | 257 | 420 | 316 | 60 | 24 | 2045 | 873 |
| TOTAL | 72 | 71 | 41 | 21 | 232 | 57 | 165 | 132 | 76 | 49 | 585 | 331 |

## TABLE D20
## SUMMARY OF STUDY AREA PROJECTIONS WITH SENSITIVITIES

| Category | YEAR | | | | |
|---|---|---|---|---|---|
| | 1996 | 2021 | | 2046 | |
| | Current | Projection | Sensitivity (%) | Projection | Sensitivity (%) |
| **RED DEER BASIN** | | | | | |
| Population | 206538 | 286,673 | + / -6.7 % | 375,696 | + / - 14.9 % |
| Withdrawal ($dam^3$) | 190616 | 295,014 | + / - 10.9 % | 390,967 | -16.8% to 17.8% |
| Consumptive Use ($dam^3$) | 159413 | 246,471 | -10.8% to 10.3% | 323,932 | -16.2% to 16.7% |
| Return Flow ($dam^3$) | 31203 | 48,543 | -11.5% to 13.5% | 67,035 | -19.5% to 23.1% |
| **BOW BASIN** | | | | | |
| Population | 878387 | 1,448,362 | + / - 5.7 % | 2,067,036 | + / - 14.8 % |
| Withdrawal ($dam^3$) | 355143 | 535,379 | -12.6% to 16.4% | 717,450 | -23.9% to 30.4% |
| Consumptive Use ($dam^3$) | 121649 | 181,755 | -10.9% to 12.7% | 241,376 | -19.8% to 23.1% |
| Return Flow ($dam^3$) | 233494 | 353,624 | -13.5% to 18.3% | 476,074 | -26.0% to 34.1% |
| **OLDMAN BASIN** | | | | | |
| Population | 152031 | 194,305 | + / - 6.3 % | 240,499 | + / - 13.4 % |
| Withdrawal ($dam^3$) | 184073 | 260,040 | -10.0% to +11.1% | 331,171 | -16.6% to 18.5% |
| Consumptive Use ($dam^3$) | 141533 | 213,230 | -9.9% to 10.6% | 275,000 | -15.6% to 17.1% |
| Return Flow ($dam^3$) | 42540 | 46,810 | -10.9% to 13.1% | 56,170 | -21.4% to 25.7% |
| **SOUTH SASKATCHEWAN SUB-BASIN** | | | | | |
| Population | 60192 | 75,823 | + / - 5.5 % | 89,865 | + / - 12.0 % |
| Withdrawal ($dam^3$) | 124588 | 156,101 | -10.0% to 14.2% | 183,784 | -18.6% to 24.4% |
| Consumptive Use ($dam^3$) | 46675 | 64,311 | -8.8% to 10.7% | 78,424 | -14.3% to 17.0% |
| Return Flow ($dam^3$) | 77913 | 91,790 | -10.8% to 16.6% | 105,360 | -21.7% to 30.0% |
| **TOTAL SSRB** | | | | | |
| Population | 1297147 | 2,005,162 | + / - 5.9 % | 2,773,096 | + / - 14.6 % |
| Withdrawal ($dam^3$) | 854420 | 1,246,535 | -11.3% to 13.7% | 1,623,372 | -20.1% to 24.2% |
| Consumptive Use ($dam^3$) | 469270 | 705,767 | -10.4% to 11.1% | 918,733 | -16.8% to 18.5% |
| Return Flow ($dam^3$) | 385150 | 540,768 | -12.6% to 17.1% | 704,639 | -24.4% to 31.7% |

# APPENDIX E

## Population Projections Review

UNIVERSITY OF ALBERTA

November 14, 2000

Bob Morrison, Water Planner
Bow Water Management
Alberta Environment
Suite 200
3115 - 12 Street N.E.
Calgary, Alberta, T2E 7J2

Dear Mr. Morrison:

**South Saskatchewan River Basin Non-District Water Use Projections study**

What follows are my comments regarding the population projections prepared for the South Saskatchewan River Basin Non-District Water Use Projections Study. These comments are grounded on the projection series and methodology notes made available through the cooperation of Paul Cox of Canadian Resource Economics Ltd.

It is obvious that future populations depend on many social, economic and technological factors that cannot be taken into account in the methodology of any population projection. Projections of populations beyond a 20-year period can be very unreliable and for this reason, Statistics Canada and other government agencies rarely make projections beyond twenty years into the future. The interaction effect of these factors upon the outcome of fertility, mortality and migration over the projection period are difficult to anticipate. The length of the projection period merely compounds these problems. Correspondingly, the longer the projection period, the greater the potential error in the projected population. For this reason, the primary assumptions set for population projections normally include that there will be no war or internal conflict affecting the area or region for which the projections are made; and that there will be no major changes in the economy or political structure in the projection region. These primary assumptions would obviously apply for the entire projection period from 2000 to 2046.

The essential components of any projection series are the assumptions made concerning the levels of fertility, mortality and migration. The methodology in this projection series assumes that the population growth from 1996 to 2046 will reflect the prevailing fertility, mortality and migration levels experienced from 1981 to 1996. While fertility and mortality will likely continue to be low, fluctuations in migration may be the disturbing component in any Alberta population projection series. A brief supporting statement follows for each of the essential assumptions for fertility, mortality and migration.

**Canadian Studies in Population**
Department of Sociology

5-21 HM Tory Building • University of Alberta • Edmonton • Canada • T6G 2H4
Telephone: (780) 492-5941 • Fax: (780) 492-9958
www.ualberta.ca

**Fertility.** A period of high fertility followed the close of World War Two in Alberta as a consequence of oil and gas explorations. These economic developments encouraged a relatively higher flow of in-migration of younger populations into the province. This economic prosperity coupled with the resumption of family formation following the cessation of hostilities brought about higher fertility rates in Alberta than the national average. Although declining, this higher fertility trend in Alberta relative to other provinces has continued to 1996.

The total fertility rate (TFR) for Alberta has been at below replacement level for a significant number of years – from 2.02 in 1974 to 1.72 in 1996. A total fertility rate value of 2.1 births per woman, normally called replacement fertility, is required in order to offset the effects of mortality over the childbearing age span, ages 15 to 49 years. The total fertility rate is the standard measure of the reproductive behaviour of women in their primary childbearing years. For example, a total fertility rate of 1.72 is translated to mean that on the average a woman can expect to have 1.72 children by the time she completes her childbearing years.

**Total Fertility Rates for Selected Years**
**Alberta and Canada: 1931-1996**

| Year | Alberta | Canada |
|---|---|---|
| 1931 | 3.38 | 3.20 |
| 1941 | 2.83 | 2.83 |
| 1951 | 3.72 | 3.50 |
| 1961 | 4.27 | 3.84 |
| 1971 | 2.43 | 2.19 |
| 1981 | 1.86 | 1.61 |
| 1986 | 1.85 | 1.56 |
| 1987 | 1.82 | 1.54 |
| 1988 | 1.84 | 1.57 |
| 1989 | 1.90 | 1.62 |
| 1990 | 1.89 | 1.68 |
| 1991 | 1.89 | 1.70 |
| 1992 | 1.85 | 1.69 |
| 1993 | 1.79 | 1.66 |
| 1994 | 1.80 | 1.66 |
| 1995 | 1.77 | 1.64 |
| 1996 | 1.72 | 1.59 |

Source: 1931-1981 data from Romaniuc, A. Fertility in Canada: From Baby-boom to Baby-bust. Cat. 91-524E. Statistics Canada, 1984. Tables 1.1 and 1.3. 1986-1996 data from Statistics Canada. Births and Deaths. Cat. 84-210XPD; and The Daily Website, July 8, 1998.

It should be emphasized that the total fertility rate is based on the childbearing experience of all women in the normal reproductive age groups within the province. Accordingly, the fertility behaviour of immigrant and Canadian-born women is accounted for in the analysis of the provincial total fertility rate preparatory to determining the appropriate fertility assumptions to be utilized in any population projection series.

It is likely that fertility will continue to decline in response to further improvement in women's economic status. The participation of women in the work force is likely to escalate because of the dynamics of social change surrounding the role of women in our society, continued improvement in the work environment and the economic need for dual-earner partnerships in order to sustain desired lifestyles. Census figures for 1991 revealed almost 60 percent of all women over the age of 15 years participating in the labour force, with Alberta reporting the highest participation rate with 66 percent. It is likely that the rate of female participation in the labour force will be sustained at high levels in the years to come. It has been noted that an increasing number of women are also engaging in more permanent and highly skilled jobs. The dual earner family has become increasingly prevalent in Canada, with 60 percent of all families having both husband and wife actively engaged in the labour force. These require greater work commitment, thus making the dual role of parenting and working more difficult. Women, including those with young children, are likely to continue working outside their homes. Between 1981 and 1991, the labour force participation of mothers with children under the age of six years increased from 49 to 69 percent.

Over the past decade several notable changes affecting marriage, divorce and living arrangements have occurred that will continue to exert a negative influence on the reproductive behaviour of Alberta women. Marriage rates have declined and divorce rates have increased substantially, particularly for the prime marriage ages, decreasing the population exposed to the risk of marital pregnancy. The combination of increasing age at first marriage, women's entrenchment in the labour force, as well as the increasing popularity of cohabitation among young and old alike in Alberta as a viable alternative to marriage further stimulates this decline in fertility.

With these economic and social forces influencing the fertility behaviour of Albertans, it is suggested that a low fertility assumption would be appropriate. A fertility assumption ranging between 1.66 to 1.70 would be an appropriate for Alberta in the foreseeable future.

**Mortality.** Life expectancies of Albertans are among the highest in the world. Mortality has been quite low in Alberta for several decades and has portrayed modest declines over the past decade. Life expectancies at birth have increased from 73.9 in 1986 to 76.0 in 1996 for males and from 80.0 to 82.4 years for females over the same period. Most mortality decline in Canada was absorbed by mid-century with the advancements made to control childhood diseases and to lower infant and maternal mortality. Since the 1950s, mortality declines have been extremely modest with gains made in preventing deaths due to the infectious-parasitic disease (childhood diseases) being offset by degenerative diseases associated with an aging population.

The already very low mortality and the small changes in projected mortality by Statistics Canada suggest that a low to medium mortality assumption could be selected for any Alberta population projection series. This would place the life expectancy at 78 to 79 years for males and 83 to 84 years for females.

**Life Expectancies at Birth**
**Alberta and Canada: 1981, 1986, 1991 and 1996**

| Year | Alberta | Canada |
|---|---|---|
| **1981** | | |
| **males** | **72.2** | **72.1** |
| **females** | **79.3** | **79.2** |
| **1986** | | |
| **males** | **73.7** | **73.3** |
| **females** | **80.3** | **80.0** |
| **1991** | | |
| **males** | **75.1** | **74.6** |
| **females** | **81.2** | **81.0** |
| **1996** | | |
| **males** | **76.1** | **75.7** |
| **females** | **81.5** | **81.5** |

Source: Statistics Canada. Report on the Demographic Situation in Canada 1994. Cat. 91-209E. p. 13 and Statistics Canada. Report on the Demographic Situation in Canada 1997. Cat. 91-209XPE. p. 17.

**Migration.** Given the volatility of migration in Alberta's population scenario, this demographic variable becomes the key factor in projecting future populations. Migration can vary substantially from year to year in response to changing economic conditions. During the oil boom period in the late 1970s and early 1980s, Alberta gained more than 50,000 persons from net migration. With the following recession period, Alberta's gain due to migration declined to 12,000 during the early 1990s – most of this gain was a consequence of international migration.

Over the past twenty years Alberta has manifested higher fertility, higher life expectancies and more economically driven migration patterns than other provinces in Canada. Hence, the migration component is often the most difficult component to assess in any projection series. Given the volatility of migration in Alberta's population scenario, this demographic variable becomes the key factor in projecting future populations. Migration can vary substantially from year to year in response to changing economic conditions. During the oil boom period in the late 1970s and early 1980s,

Alberta gained more than 50,000 persons from net migration. With the following recession period, Alberta's gain due to migration declined to 12,000 during the early 1990s – most of the gain was a consequence of international migration.

**Net Interprovincial and International Migration**
**Alberta: 1997-2001**

| Year | Net Interprovincial Migration | Net International Migration | Total Net Migration |
|---|---|---|---|
| 1997 | 24,710 | 10,000 | 34,710 |
| 1998 | 21,000 | 10,000 | 31,000 |
| 1999 | 19,000 | 10,000 | 29,000 |
| 2000 | 15,000 | 10,000 | 25,000 |
| 2001 | 15,000 | 10,000 | 25,000 |
| 1997-2001 | 94,710 | 50,000 | 144,710 |
| | | Average = | 28,942 |

Source: Alberta Treasury, Alberta Population Projection: Census Divisions, 1995-2011 Correspondence, dated July 20, 1998.

Alberta's economy has been expanding in recent years, hence creating an increasingly popular destination for inter-provincial migrants. Changes in the Asian markets, internal labour markets and increasing costs of living have influenced a reversal in migration from British Columbia to Alberta. The national and provincial economic levels are not likely to change in the short term and will continue to sustain current levels in international and internal migration. Correspondingly, the Canadian Resource Economics group applied minor adjustments in selected sub-basins in accordance with reasonable expectations of economic growth.

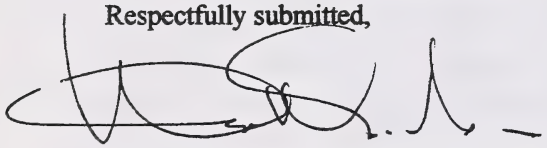
**Methodology**. The projection series prepared by the Canadian Resource Economics group are generated utilizing an approximate component methodology. Reliable population estimates for small areas, such as the study sub-basins, are simply unavailable. In contrast to the United States Census Bureau, Statistics Canada has avoided providing small area estimates for Canada because of the risk involved in attaining accuracy for small areas. Any subtle changes in the levels of fertility, mortality and migration can have profound effects on small area population estimates.

This population projection approach incorporated the most reliable and recent population estimate/census results available for the projection region. These were selected from available population estimates prepared by local administrative units for planning and budgeting purposes. Population projections are essentially concerned with future populations, and in this projection series, specifically with the future growth of the southern watershed region in the province of Alberta. This undertaking required the

review and assessment of the individual population estimates from a variety of sources for all sub-basins that comprise the entire projection region. It is imperative to understand that sub-basin estimates and/or projections have been prepared by a variety of reputable statistical agencies utilizing a range of projection assumptions. These statistical agencies include Statistics Canada, Alberta Municipal Affairs, Alberta Treasury, Alberta Health, Cities of Calgary, Lethbridge, and Red Deer Finance Departments. The Canadian Resource Economics group executed this review and detailed assessment in order to select the most reasonable sub-basin population data sets from these sources to use as the starting point of the projection series.

The next sequence of steps necessitated the calculation of a measure of population growth over the most recent census periods from 1981 to 1996. This procedure generated an annual growth rate or annual percentage change for each sub-basin. These growth rates were then compared with the growth rates generated in the Statistics Canada and Alberta Treasury data series for consistency. A mathematical technique was then incorporated for averaging these population growth rates over the projection period for the sub-basins, assuming no change in the fertility and mortality levels. Holding the line with respect to the fertility and mortality assumptions is appropriate. Upon completion of these projection series, necessary adjustments were made in accordance with prospective economic changes for each of the sub-basins. This procedure is a most common methodology employed in the generation of population projections that involve multiple small sub-areas and an inordinately long projection period. This methodological approach is appropriate given the difficulty in projecting populations for small areas over an extremely long projection period.

Respectfully submitted,



Wayne W. McVey, Jr.
Professor Emeritus
Editor, Canadian Studies in Population

copies to:
Paul Cox, Canadian Resource Economics
✓ Dave Cooper, Hydroconsult

# APPENDIX F

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## APPENDIX F BIBLIOGRAPHY


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**Hydroconsult**
**EN3 Services Ltd.**
3100, Bow Valley Square II
205 - 5 Avenue S.W.
Calgary, Alberta, Canada T2P 2V7
Ph: (403) 265-6958
Fax: (403) 263-9818
Email: hydroconsult@hydroconsult.com
Web: www.hydroconsult.com